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THE

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PETROL-ELECTRIC OR PLAIN ELECTRIC RAIL MOTORS?

IN 1904 Mr. Dawson discussed in the *Street Railway Journal* the merits of all the independent rail cars then in use. He showed how experience in Italy, France and Würtemburg had resulted in the condemnation of accumulator cars; how steam cars were in use in Belgium, France and England; how the N.E.R. were experimenting with the petrol-electric system, and finally, how he emphatically recommended the plain petrol drive. The Editor backed that recommendation.

In the same year a valuable report of 73 pages was presented by Herr Ziffer to the Thirteenth Conference of the International Union of Tramways and Light Railways. This covered the whole field of practice in independent rail motors, and included an account of what may be called dependent electrical operation, as distinct from self-contained petrol-electric or accumulator cars. In the conclusion of this report, Herr Ziffer sums up in favour of steam traction, and prefers a system of light locomotives rather than the self-contained steam-driven car. His objections to petrol motors include complexity and delicacy of mechanism, great loss of energy due to the presence of gears, nauseating smell of the exhaust, noise, jerks and vibration, besides limited range of speed and small overload capacity.

Gas motors and accumulators are not in the running, and alcohol motors are not out of the trial stage, but evidently he has hopes that the recent trials of dependent electric cars, especially those to which high-tension alternating current is transmitted, may give economical service.

Mr. F. Hild declares in a paper read before the Iowa Street and Interurban Association (*Street Railway Journal*, May 5th) that the fight for the particular field of transit which everyone admits to be best served by single cars or very short trains, is between the petrol-electric and the "Standard" electric systems, being thus in opposition to Messrs. Dawson and Ziffer. It must be remembered, however, that he is writing in 1906, while the others wrote in 1904. So little had been done in petrol-electric propulsion at that time that the N.E. Railway experimental coach was the only example to hand, and very little more than preliminary trials had been made of any dependent electric system for this service.

The United States have gone ahead since then, and Mr. Hild mentions the Burlington, Delaware and Hudson, Lake Shore, and St. Joseph Valley Railways, as experimenting with the mixed system, while the Union Pacific is trying the direct petrol drive, and the Ohio River and Columbus Railway a steam car.

The tendency in England is strongly towards the steam rail car, so that the ultimate decision of the world, if there

ever be such a thing, will be a speculative point for some time.

Mr. Hild considers the independent car at a disadvantage as compared with the dependent electric car on the following points :—

Total weight, weight per seat, and, we may add, initial cost and maintenance of track.

Acceleration and schedule speed.

Attendance, maintenance, complexity and reliability.

Overload capacity, size of motor and load factor.

Reciprocating motion.

Noise.

He compares the working costs of petrol-electric and dependent electric, and finds that the former is 5·3d. per car-mile against 2·07d., but the latter remarkably favourable figure for cars weighing 30 tons run over 25 miles of route at 25 miles per hour may be taken with some reserve. It is noteworthy that the losses in the return circuit seem to be ignored, whilst the efficiency of the single-phase motors of the dependent car is assumed to be equal to the efficiency of the D.C. motors of the petrol-electric car.

Going on to compare first the capital costs and then the total costs of the two systems under similar conditions and a run of 900 miles per day, we get :—

CAPITAL COST.

1. *Independent*—	
4 motor-cars and two trailers	£14,800
2. *Dependent*—	
Power plant	£9,000
One sub-station	400
Distribution system	9,600
4 cars and 2 trailers	7,200
Rail-bonding	1,250
	£27,450

Working Cost—	
1. Independent	7·5d.
2. Dependent	3·03d.

Total Cost per Diem —

	(1)	(2)
Working	£26·3	£10·89
Interest and depreciation at 10 per cent. ...	4·06	7·52
	£30·36	£18·41

thus showing a saving for the dependent system of about £4,500 per annum.

Carrying the same sort of calculations further, and bringing into them steam trains, each consisting of a loco., tender and two cars, Mr. Hild finds that the petrol-electric unit is the cheapest for anything under 300 miles per diem, that the steam train beats the dependent electric up to 100 miles per diem, but that for anything over six round trips (300 miles) the latter outruns all competitors by an always increasing margin.

We do not apprehend the author's reason for taking such a comparatively heavy steam unit, and would much rather have had him use something more like our familiar and successful G.W. Railway rail cars. Moreover, the capital cost of the generating plant looks rather on the side of skimpiness, considering that provision has to be made for four 120-H.P. cars and two trailers, and that the load-factor of such an outfit will be miserably small.

Nevertheless, we must give Mr. Hild credit for knowing his own conditions, which are not likely to be as exacting as we might expect to meet here ; and we consider the paper the genuine product of an open mind which courts rather than defies criticism.

South African Electricity Works.

WE publish this week a revised list of South African electricity works and tramway undertakings. We have every hope that these tables will be of as great interest to central station engineers, electrical manufacturers and others, as on a previous occasion, and we take this opportunity of tendering our thanks to South African engineers who so willingly supplied the various data. In comparison with our first list published in the ELECTRICAL REVIEW of September 30th, 1904, the list is much extended, stations that were then in progress being now in operation. The fact that there are none in progress now (other than Johannesburg and Port Elizabeth, both of which are already giving a limited supply) is accounted for by the trade depression, which, unfortunately, still exists in South Africa. The schemes in contemplation have failed to increase in number through the same cause, but we note that some are of an important nature, and in view of the rapid growth of engineering in South Africa we have reason to believe that English engineers will not be behind-hand in following up such matters. It is well known that English engineers are now carrying out the largest electrical scheme in South Africa, that of Johannesburg, where the adoption of gas-driven electrical machinery on such a large scale is a new departure in central station practice, the results of which will be watched with much interest. It is especially interesting at this time, when the use of overhead mains is being advocated in England, to note that the majority of South African towns have adopted overhead mains for low-tension distribution, without which it would not have been commercially possible to supply the smaller towns, whose populations are only from 2,000 to 3,000.

For the Rand supply it seems that we may expect important developments almost immediately. The Rand Central Electric Works Co., which had considerable difficulties to contend with, is now doing well, as will be seen from a report in our "City Notes" pages this week. The company is on the alert preparing for the competition which, with some justification, it anticipates.

Though storms are very severe in Africa, little trouble is experienced from lightning, owing to proper protection being provided in the shape of arresters and guard wires ; and accidents to the public are of rare occurrence, for, with a careful patrol of the lines, it is a simple matter to maintain them in a state of efficiency.

Aliwal North, in Cape Colony, holds the unique position of being the only municipality generating electricity solely by water-power. Cape Town has water-power for a supplementary supply. There are a few other private water-power plants in operation, but generally the use of water is of a restricted nature, owing to the dry seasons experienced.

Steam Turbine Fallacies.

IT has been proposed that steam should be used to drive a turbine by first condensing it in a jet of water in an injector and using the comparatively slowly moving jet of water to drive an impulse wheel or other form of water motor. Mr. Neilson scouts the idea in *Power* because, if, by dilution with water, the weight of working fluid is doubled and its velocity is halved, its capacity for doing work will be quartered, whereas, if steam were used on a wheel run at half speed, not more than 25 per cent. of loss would be incurred. While this is perfectly true, the fact remains that the leakages of a turbine and the ineffective work or eddy currents set up by indirect flow and improper impingement are large detractors from efficiency, so that the dilution idea, though hardly likely to succeed, might not on trial be found so far behind as the application of theoretical reasoning seems to show. The trouble is that the velocity of steam is so great that no mechanism has successfully solved the problem of dealing with it in kinetic mass energy. The piston engine deals solely with the kinetic molecular energy of the steam, and the molecules being perfectly elastic so long as they are dry the piston engine represents a more scientific method of using steam than does the turbine. Indeed, had we had only the turbine and some believer in the kinetic theory of gases had just discovered the piston engine and the method of employing molecular bombardment to cause movement in that piston, he would probably have been regarded as a man of genius. Now in a piston engine no molecular energy is lost by useless bombardment of the sides of the cylinder unless these are colder than the molecules, when the molecules are robbed of elasticity and fail to rebound so perfectly and give us the phenomenon which we call cylinder condensation. In the turbine the designer endeavours to induce the gaseous molecules to travel in parallel lines, and so far as he can do this he

obtains effective work from them. But they do not readily flow in parallel lines and there is a good deal of confused movement and loss of energy, for it must not be forgotten that a backward eddy will obstruct the rotation of the wheel. The De Laval steam turbine is more scientifically correct than any turbine of multiple rings can be. In an outflow nozzle steam can be directed to flow with some fair approximation to molecular parallelism, and its kinetic energy is taken out of it at one pass. But in a multiple-ring turbine there are no jet-forming guiding nozzles, and all the passage way of obstructing blades is more or less obstructive and unscientific. The Laval suffers because it cannot be allowed to move as fast as it ought to do, or at half the jet velocity. Theory would point to a series of Laval wheels each with its forming nozzle, and some of the now numerous types of turbine approximate to this condition. The whole subject bristles with difficulties from every point, but in whatever way a solution may be attempted, the great fact remains that the turbine is a rotary machine, and as such makes a claim on engineers who have done most of their mechanical work by means of simple rotating bodies such as wheels, spindles, &c. Designers of turbines should not overlook the reasons why the reciprocating steam engine falls so far short of what it ought to accomplish, and one of the main reasons is, of course, the failure of the cylinder walls to throw off the molecules with their full heat elasticity. Those which strike the moving piston must obviously fly back with less velocity because the piston is moving, and this is how they give up energy to the piston, for they strike it with a velocity v and leave it with a velocity $v - v$, so that the energy lost is $(2\,v\,v - v^2)$, or practically $2\,v\,v$, since v^2 is so very small as compared with v. So also should the turbine avoid the causes which may produce similar effects.

Power House Economies.

Mr. W. P. Hancock's article on this subject in a recent number of *Cassier's Magazine* suggests at the outset that the author's talents would be more adequately remunerated in another sphere than engineering. Literary coruscations of the following types are suggestive of the solicitous inquiries prefacing a request to buy "somebody's pills." In the author's exact words: "Are you looking closely after some of the very important items of power house operation which, generally speaking, are not discussed very much in detail? For instance, consider the matter of fuel . . . . Are you provided with coal-handling apparatus which will enable you to unload the fuel quickly and at low cost, and also such handling apparatus as will enable you to handle over from 40,000 to 75,000 tons of fuel in case there is a tendency towards heating? . . . . How about the repairs in the boiler room? Are you keeping them up just where they ought to be kept? Have you acquired the habit of saying 'We cannot afford to fix that matter up now, not until next month'? . . . . Does your cylinder oil cost too much or too little? It is perfectly possible that either one of these conditions may exist . . . . Are you using a very cheap cylinder oil, so cheap, in fact, that you must send through to the inner parts of the unit an abnormal quantity?"

Despite these flavours of the advertisement column, the advertisement does not follow. While disclaiming any desire for pedantry in regard to the composition of literary work of a technical character, we at first thought of asking the author whether he was addressing his remarks to the British or American readers of that magazine. On reflection we concluded that the chief of an English central station who needed to be addressed in the following terms was about as common as the Jabberwock. Mr. Hancock asks, "By the way, how do the engineers and switchboard men co-operate? In other words, how are the units being loaded? Are you getting such a low load on some units that the consumption of steam and oil is wasteful? Can you not step inside at times and try to see how the load could be better divided, so that you could operate to a better advantage as to economy?"

With insular conceit and unwrung withers we can express the hope that those trans-Atlantic engineers who need to have the elements of central station economy taught them in this guise, will soon learn the lesson the author teaches in such a striking manner.

THE "VICKERS-HALL" SYSTEM OF ELECTRIC LIGHTING FOR RAILWAY CARRIAGES.

The problem of lighting railway carriages by electricity has occupied the attention of inventors for at least a score of years, and has come prominently to the fore of late—partly, no doubt, owing to the dangers inherent to the use of gas and oil, which have been only too clearly demonstrated in recent railway accidents. The only system that has been adopted in practice to any important extent is that in which the current required is generated by a dynamo driven from the car axle, provision for lighting during stoppages being made by means of accumulators charged from the dynamo. Coaches lighted on this system are self-contained, and, by means of various automatic devices, can be made to run without any attention beyond switching on the lights as required, and an occasional inspection of the apparatus.

The chief difficulties to be overcome are the following:—

1. Provision must be made to allow the dynamo to generate current always in the same direction, whatever its direction of rotation.

2. The dynamo must be automatically switched in as soon as its voltage reaches the correct amount, and switched out again when it falls below that value.

3. As the speed of the car axle varies considerably, the variations of voltage naturally due to this must be either obviated, or, at all events, minimised to such an extent as to be negligible.

Various contrivances have been introduced to overcome these difficulties. Some makers have effected the automatic processes mechanically, others electrically; each method has its advantages and disadvantages. In the "Vickers-Hall" system, which is here described, a combination of the two methods is adopted, with a view to securing the chief advantages of both.

The apparatus employed in this system consists of four pieces of mechanism—the dynamo, the controller box, the main switch, and the output adjuster (see fig. 1, p. 868). Besides these there are two batteries, each of either 12 or 15 cells, according to the voltage desired. The dynamo and batteries are placed beneath the coach, the switch either inside or at the end, and the remaining apparatus inside. The switch is only placed at the end for compartment coaches; it is then of a different type to that shown in the diagram, and is actuated by a pull rod.

As the dynamo is tightly belted to the car axle, and consequently follows it as to both direction and speed of rotation, it results that special means have to be provided to ensure that the potential difference between the dynamo terminals shall be always in the same direction, and shall not become excessive at high speeds. These objects are effected by means of a pole-changing switch and actuator, and a centrifugal governor combined with a sliding switch or "slide." A second sliding switch, operated by the same governor, is provided to prevent fluctuation of the lights at starting or stopping. The pole-changing switch and the two slides are shown on the diagram, but without the mechanism which actuates them. The action of the pole-changing switch is easily seen by reference to the diagram, where the armature is supposed to be turning clockwise. If the direction of rotation be reversed, the polarity of the brushes will also be reversed. At the same time, however, the central portion of the switch is caused automatically to rotate in the same direction as the armature for about 30°. The left-hand brush is now in contact with the bottom terminal, and the right-hand brush with the outer terminals, thus keeping the direction of the E.M.F. the same as regards the external circuits.

The two slides are, to all intents and purposes, resistance switches composed of contacts which, when the dynamo is at rest, are all short-circuited by the brush. As the speed rises the brush is gradually withdrawn, thus breaking the connections between the contacts one after another.

The dynamo field has two windings: an ordinary exciting shunt winding, and a demagnetising series winding, wound in such a direction as to oppose the shunt. The first few contacts on the regulating slide are, as may be seen by the diagram, connected to various points on this winding, so

D

that when the train is at rest the whole of the series winding is short-circuited, but as the speed of the train rises, the main current is made to traverse one section after another of the demagnetising windings until the whole are in circuit. By this means the field is weakened as the speed rises, so that the output never becomes excessive.

in a resistance known as the "lamp resistance," the function of which will be explained later. This resistance, like the shunt resistance on the regulating slide, is built up on the slide, and forms part of it.

The next most important piece of apparatus is the controller box, shown in figs. 1 and 2. This contains the

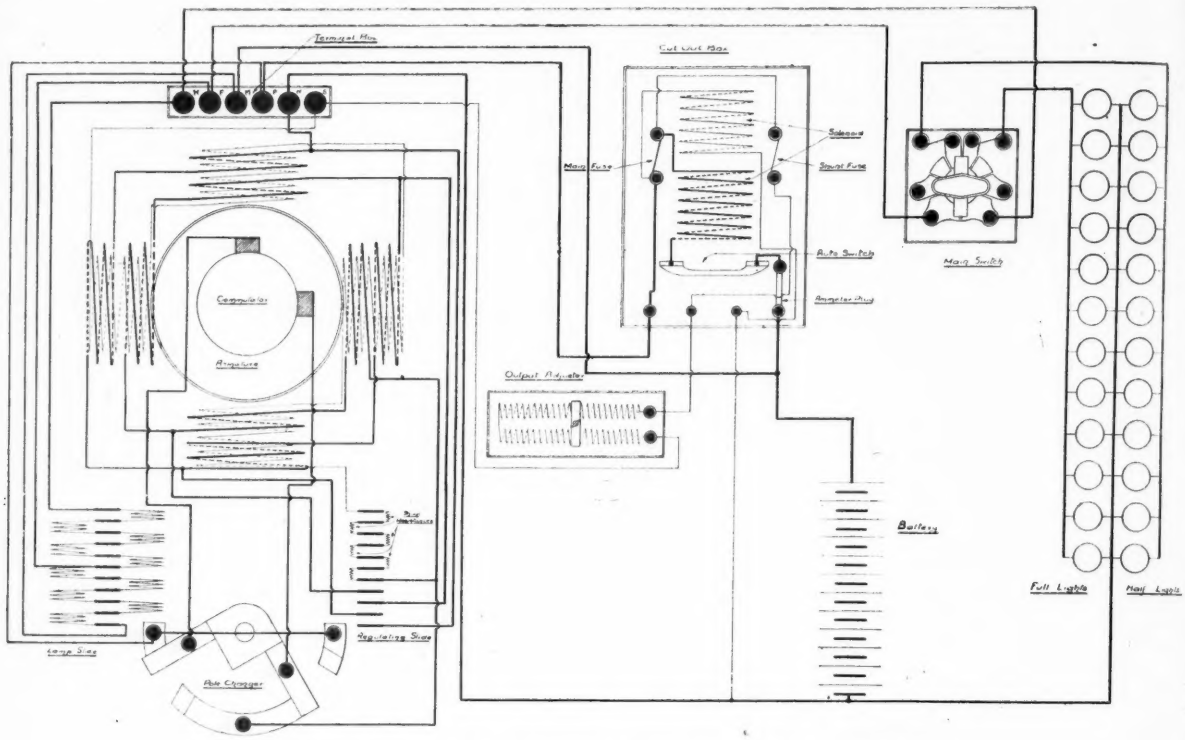


Fig. 1.—General Diagram of Connections; Vickers-Hall Train-Lighting System.

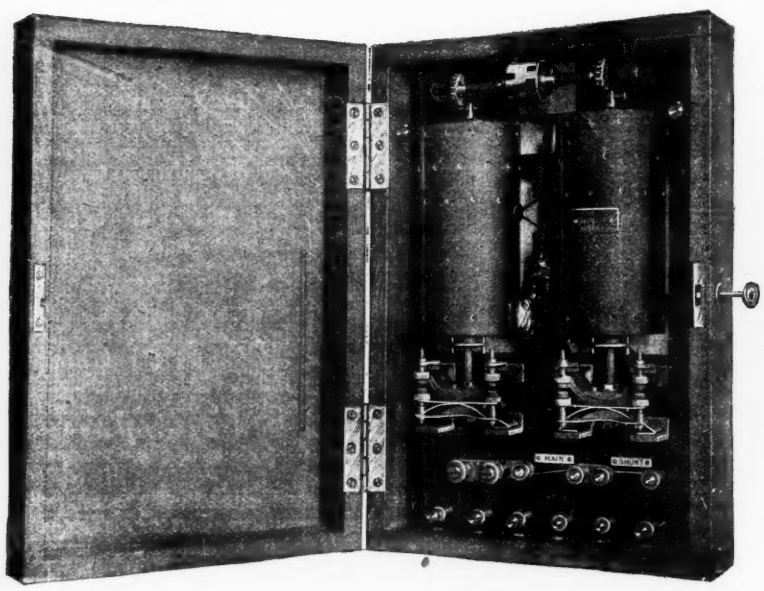


Fig. 2.—Controller Box.

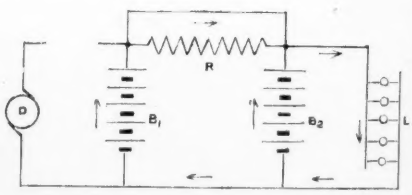


Fig. 3.—Batteries Feeding Lamps.

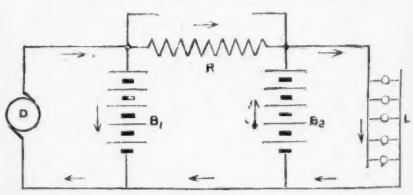


Fig. 4.—Dynamo Charging B_1 and Feeding Lamps in Parallel with B_2.

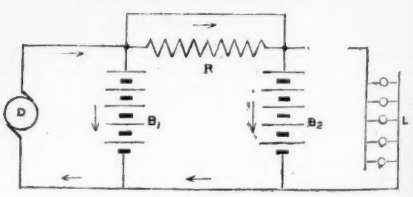


Fig. 5.—Dynamo Charging Batteries.
D, dynamo; L, lamps; B_1, B_2, batteries; R, resistance.

The remaining contacts on the regulating slide are connected to various points of a small resistance in the shunt circuit. This is introduced to weaken the field still further when the speed rises, after the series windings are all in circuit. For the sake of convenience, this resistance is built up on the slide, of which, in fact, it forms a part. The lamp slide is used for the purpose of gradually cutting

mechanism for automatically switching off and on, as required, the dynamo and battery. The mechanism consists of two automatic change-over switches worked by solenoids, and a change-over or selector switch. The solenoids are compound wound, the shunt coils being energised alternately every time the train starts, by means of the selector switch. When at rest, both

batteries are connected by the two auto-switches to the lamp switch. When the train starts, the shunt winding of one of the solenoids is energised, and, as soon as the dynamo has reached a suitable voltage, draws up its plunger, and switches the corresponding battery off the lamps and on to the dynamo.

The resistance before mentioned as being mounted on the lamp slide is connected between the positive poles of the two batteries, so that, instead of the whole of the dynamo current going to one battery, while the other battery feeds the lamps, a large proportion of the lamp current is supplied direct from the dynamo. This prevents the wide variations of voltage which might otherwise occur owing to one battery

sufficiently clear from the diagram. The output adjuster consists of a variable resistance in the shunt circuit of the dynamo, by means of which the output of the machine can be adjusted as required to suit the conditions of running. The action of the system is as follows :—

When the train is at rest, and lights off, no current passes in any portion of the system, and the conditions are as shown in fig. 1.

Should the lights be now switched on, neither solenoid in the controller box being excited, both batteries remain directly connected by the two auto-switches to the main switch, and so supply the lamps in parallel, as in the diagram, fig. 3.

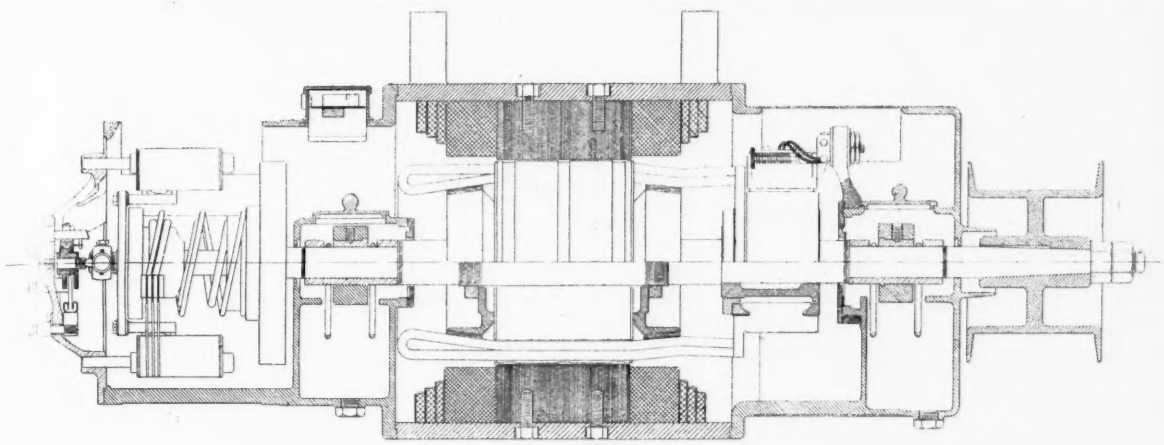


Fig. 6.—Longitudinal Section of Dynamo and Governor.

being discharged, and then suddenly replaced by a fully-charged battery at each stop. The object of having a resistance arranged on a slide as described is that it is thus introduced and taken out gradually, so obviating any jump in the lights when cutting in or out.

The main current from the dynamo passes through the series coils of the excited or "up" solenoid on its way to the lamp slide, thus strengthening the pull of the solenoid,

If the train now starts, the dynamo armature being driven from the carriage axle will, of course, commence to rotate, its speed rising with that of the train. It will, therefore, commence to generate an E.M.F., which, as the dynamo is now running as a shunt machine on open circuit, increases very rapidly with the speed. As soon as the voltage reaches a certain predetermined limit, one of the cut-outs will rise, and connect the corresponding battery to the

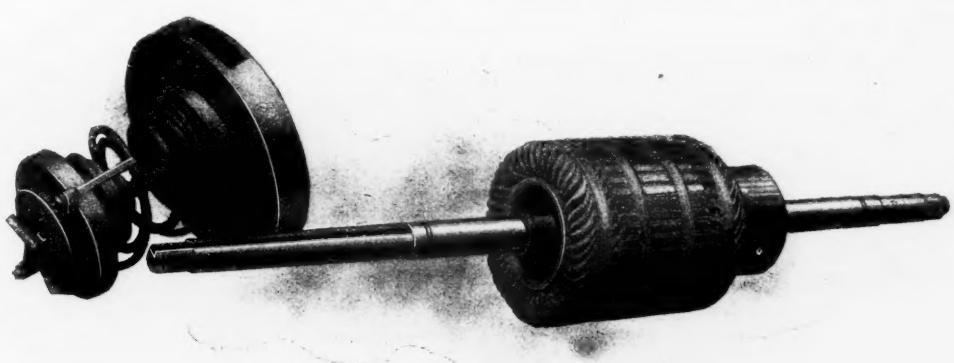


Fig. 7.—Armature, with Governor Removed.

and improving the contact of the auto-switch. When, however, the train stops, and the voltage of the dynamo falls below that of the batteries, the reverse current passing from the batteries to the dynamo exercises a powerful demagnetising effect on the solenoids, and the plunger is drawn down by the action of a spring, thus disconnecting the battery from the dynamo, and connecting it to the lamps. The change-over or selector switch is operated by means of ratchets from the plungers, shown in fig. 2, so that the solenoids are excited in turn, and a different battery is charged after each successive stop.

Besides the mechanism the controller box contains two fuses, one in the main, and one in the shunt circuit of the dynamo, and an arrangement whereby an ammeter may be placed in circuit with the dynamo for testing purposes.

The main switch requires no description, its action being

dynamo. As the resistance on the lamp slide is still short-circuited, the dynamo and both batteries are now connected in parallel to the lamps. Seeing that the dynamo is at this point giving only a small output, no rise of voltage on the lamps will result. As the speed of the dynamo, and with it the output, continues to rise, there would naturally tend to be a rise in the voltage of the system due to the excess of the dynamo output over the lamp current charging the cells, and so raising the voltage. This is, however, prevented by the resistance on the lamp slide, which is now cut in so as to intervene between the positive poles of the two batteries. Thus the system is now divided into two portions, one consisting of the dynamo and one battery, and the other of the second battery and the lamps (see diagram, fig. 4). The lamp resistance is so proportioned as to allow at each speed sufficient current to pass between the two portions to supply the lamps.

Thus, the voltage of the battery attached to the lamps is not appreciably affected, and as the voltage of the lamps depends upon this, they will continue to burn at the correct pressure. The back E.M.F. of the other battery, which is being charged, will rise, and with it the voltage of the dynamo, but owing to the interposition of the lamp resistance the lamp voltage will not be affected. The course of the current under these conditions is shown in fig. 4.

If the lamps be now switched off, the positive poles of the two batteries will be connected together by means of the switch brush connecting the short-circuiting contacts on the main switch, as shown in fig. 1, and the diagram, fig. 5. The dynamo will, therefore, charge the two batteries in parallel.

On stopping, the system will revert to the conditions of fig. 1, or, if the lamps are on, fig. 3. The same cycle of operations will be repeated on starting again, except that, owing to the position of the selector switch being changed at the moment of cutting-out by the ratchet attached to the solenoid plunger, the other solenoid will now be excited, and the positions and functions of the batteries will be interchanged.

The advantages of this system are many and obvious. In the first place, there is no slipping belt or other frictional device, with its attendant low efficiency, constant wear and vibration. The armature is a very simple one, with a single winding, only one commutator, and only one pair of brushes (see section, fig. 6). No double armatures, short-circuiting brushes, or other complications are required, and the dynamo proper is, except for the inverse series coils, similar to an ordinary stationary machine. The regulating mechanism, though contained within the same casing, is really separate from the machine (as shown in fig. 7), and can be detached and re-attached in the space of a few minutes. Being of thoroughly sound mechanical construction and very carefully designed, with ball or roller bearings in all frictional parts, it is practically indestructible with fair usage, cases having been known of some of these governors running 100,000 miles without attention. When then examined, they showed no sign of wear. The slides require inspection about once a quarter, in order to see whether they require cleaning. The pole-changing mechanism also requires very little attention, the wear in the latest type being confined to three parts, all of which are small, cheap, and easily replaced. They require inspecting about once a year, and should last for years. Fig. 8 is a general view of the complete machine.

The remaining portion of the mechanism, *i.e.*, the controller box, is placed in an easily accessible position inside the coach. It requires inspecting about every six weeks, but beyond occasionally replacing the carbon breaks when necessary, it will with fair usage need no attention.

The control being a combination of electrical and mechanical devices, unites the delicacy of electrical control with the certainty and positive action of mechanical operation. The weakening of the fields by means of inverse series coils is found to give more satisfactory results than simply introducing shunt resistance, as it is claimed that the inverse windings have a steadying effect upon the output which cannot be obtained by any other method of field control.

For compartment coaches, or other carriages having not more than 25 lamps arranged on two circuits, the Vickers-Hall single-battery system is recommended on account of its lower first cost.

It differs from the double-battery system, as denoted by its name, in having only one set of cells, the regulating battery being dispensed with. On this account, it is necessary that the lamp resistance should be accurately proportioned to the number of lamps in circuit, and for this reason its use is practically restricted to those cases where all the lamps are arranged on two circuits. Provision is made on the main switch for short-circuiting a portion of the lamp resistance when all the lights are on, leaving the whole in circuit when only half the lights are employed. By this means it is found possible to obtain the necessary regulation of the lamp voltage, while dispensing with the regulating battery.

Individually-controlled lamps, when more than one or two in number, are provided with a special compensating device of small size and cost. For compartment coaches, however, individually-controlled lights are not, as a rule, required.

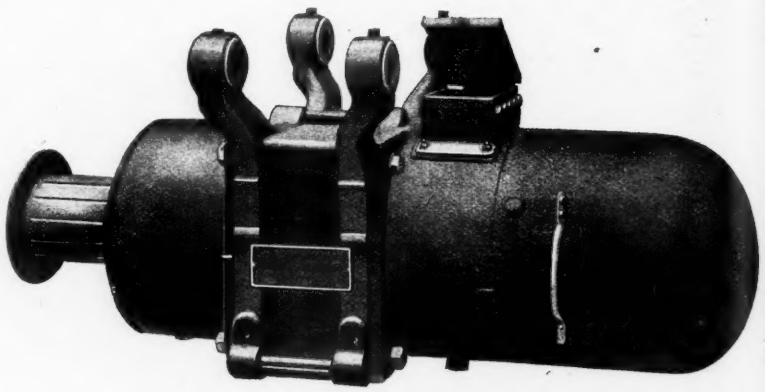


FIG 8.—VICKERS-HALL TRAIN LIGHTING DYNAMO.

The apparatus in this system is the same as that in the double battery, with the following exceptions:—

The controller box (or cut-out, as it is generally termed in single-battery working) not having to effect the changing-over of the batteries, contains, besides the fuses and ammeter-plug, only one auto-switch, the other auto-switch and the change-over switch being omitted. The auto-switch is of similar construction to those used in the double-battery system, except that the bottom contacts are omitted.

By splitting the bottom contact of the main switch in halves, and connecting that half which is opposite to the full-light contact to a terminal in the middle of the lamp resistance, and that which is opposite to the half-light contact to the end terminal of the lamp resistance, provision is made for varying the amount of resistance in circuit to suit the number of lights in use, as the main switch in the full light position thus short-circuits a portion of the lamp resistance.

The action of the system is exactly the same as with the Vickers-Hall double-battery system, except that the regulating battery is omitted, and the regulation of the lamp voltage is effected entirely by means of the lamp resistance, and the governor in the dynamo.

The low first cost and maintenance cost of this system render it very suitable for use on compartment coaches, which, of course, form the bulk of the passenger rolling stock on nearly all English railways.

We understand that several of the leading railway companies in this country are using the Vickers-Hall system; some of them have had it in use for a considerable time. The system is being put on the market by Messrs. Vickers, Sons & Maxim, Ltd., the apparatus being manufactured by the Electric & Ordnance Accessories Co., Ltd., of the Stellite Works, Birmingham.

Electric Power in Westminster.—The WESTMINSTER ELECTRIC SUPPLY CORPORATION, LTD., has issued a pamphlet of 30 pages entitled "Some Minor Applications of Electric Power for Trade Purposes and in Shops." Every left-hand page is given up to pictures of electric motor-driven examples, such as cream separators, knife cleaning and boot polishing machines, electric fans and lifts, &c., also electric heating and cooking appliances. The facing pages discuss the advantages of electricity for these purposes, and make a comparison of gas and electricity. A list of different classes of trades, and the appliances that the company can operate for each, is given. The corporation has also opened a showroom at 96, Victoria Street, Westminster, for three months, where most of the apparatus shown in the pamphlet can be seen in operation.

OPENING OF THE GREENWICH TRAMWAYS GENERATING STATION OF THE L.C.C.

On Saturday afternoon last week, the dual opening ceremonies of the new Vauxhall Bridge and the London County Council Tramways Power Station took place, Mr. Evan Spicer, J.P., chairman of the L.C.C., being instrumental in declaring both structures open. Mr. N. W. Hubbard, chairman of the Improvements Committee, presided over the former ceremony, among those present being Earl and Lady Carrington, Lord Elcho, the Dean of Westminster, and many prominent members of the Council.

The new bridge, which has a length of 760 ft. and a width between the parapets of 80 ft., consists of a steel superstructure resting on granite abutments. We regret to add that London's latest bridge is *illuminated* by 16 incandescent gas lamps, each reputed to be of 300 c.p. Altogether it has taken some eight years to construct, and its cost, including the provision of a temporary bridge and the construction of approaches, will be nearly £600,000.

Possibly the most interesting feature connected with the bridge is its double tramway track, which provides the long-wanted-for link between the Council's southern tramway system and Victoria, a point within easy reach of the West End.

After the bridge had been declared open, the chairman of the Council and his guests boarded a number of tramcars and journeyed to Greenwich, where Captain the Hon. Fitzroy Hamphill, chairman of the Highways Committee, presided at the ceremony at the power station.

Among the various speakers were Mr. Allen Baker, M.P., who was Chairman of the Highways Committee during the carrying out of a great portion of the work, Mr. J. W. Benn, M.P., Chairman of the Council during 1904-5, and others.

Description of the Station.

The power station occupies a site of $3\frac{3}{4}$ acres, with a river frontage; the site having originally been used as a tramway depôt by the Council. The station, which is intended to supply energy to the Council's tramways on both the north and south sides of the river, is in two parts, the first portion being practically completed, and the second in progress.

The station structures include a boiler house, engine room, offices, sub-station, workshop, pump and strainer houses, an outside coal bunker, and a pier for unloading purposes.

Coal is obtained from steam colliers, which can be unloaded at the pierhead by three electric grab-cranes. The grabs, which hold some 25 cwt. each, discharge into trucks on the pier; the trucks, after weighing, discharge into a 2,000-ton capacity steel bunker situated on the river bank, and constructed with a view to the rapid unloading of the vessel. The exterior bunker is connected with the ordinary bunkers over the boiler house, by two 40-ton bucket conveyors, which, following the normal arrangement, lead over the bunkers and return beneath the firing floor of the boiler-house, enabling the ashes to be removed from the basement and deposited in a storage hopper under the pier.

Twenty-four Stirling water-tube boilers, of the five-drum type, arranged in pairs, in two rows with the firing floor between, are installed in the boiler house. Each boiler is capable of evaporating 16,300 lb. of water per hour at the working pressure of 200 lb. per sq. in., the steam being superheated to a temperature of 500° F.

Each pair of boilers is provided with a Green economiser of 320 tubes, installed on an upper floor. The boiler house contains four groups, each consisting of six boilers with their economisers, on either side of the two chimneys which are situated centrally in the two rows of boilers; these boiler groups are each equivalent to one generating unit. The chimney shafts rise to a height of 250 ft., and have an internal diameter of 14 ft.

The steel bunkers over the boiler house have a capacity of 6,500 tons, and are sub-divided. The fuel falls by gravity through shoots, provided with measuring apparatus into the hoppers of the chain-grate stokers with which the boilers are equipped. The boiler house basement contains on either side, pump rooms and hotwells respectively.

Two pump rooms are provided, each containing three horizontal ram pumps, in each case driven by a 35-h.p. series-wound motor, and capable of delivering 8,000 gallons of water per hour to the boilers.

The driving motors are provided with two voltages—viz., 125 and 550—so that the pumps can be run at a low speed efficiency. The steam piping follows a simple plan; each pair of boilers feeds into the main steam header in the engine room, and from the latter branches connect to the engine separators.

The type of steam generator adopted in the engine room is unique as far as this country is concerned, and presents a marked contrast to the turbine plant of the Lancashire Power Co., described elsewhere in this issue; the four units each consist of twin vertical-horizontal Corliss engines constructed by Messrs. Musgrave, of Bolton. Two complete compound engines, each with a vertical h.p. cylinder $33\frac{1}{2}$ in. diameter, a horizontal l.p. cylinder 66 in. diameter, and a stroke of 4 ft., driving on to a common crankpin, are disposed on either side of a 3,500-kw. three-phase alternator working at 6,600 volts pressure and 25 cycles. The alternators are by the Electric Construction Co., of the revolving field type; the stators are star-wound with the neutral point earthed.

Each alternator is provided with a 125-volt rope-driven exciter, but two auxiliary steam-driven 150-kw. Belliss and Dick, Kerr direct current sets are also installed, which serve as a stand-by and for supplying certain station motor and lighting circuits, the h.t. switchgear operating circuits, &c.

The engines run at 94 r.p.m. with 180 lb. steam pressure; a reheater is inserted between the h. and l.p. cylinders, and the engines are enclosed with the exception of the valve gear, and work under forced lubrication.

The main engines are electrically controlled from the switch operating gallery, and are each provided with electrically operated barring gear. Each l.p. cylinder exhausts through a Baker oil separator into a surface condenser in the basement.

Motor-driven three-throw air pumps are installed beside each condenser, the oil circulating and hot well pumps being also driven from the same motors. The hot well water in its passage from the condenser to the hot wells, is treated in Harris-Anderson purifiers situated in the engine room basement.

A small surface condensing plant, with air pumps, &c., is provided in the basement for dealing with the exhaust from the auxiliary steam-driven sets.

A somewhat elaborate arrangement has been adopted for freeing the circulating water from dirt and grit.

Between the station and the river are situated straining and pump houses; four 30-in. pipes, bell-mouthed, lead out of the river from a point below the lowest known tide line. Three of these pipes can be used either for suction or discharge purposes; the fourth is a discharge pipe only.

The suctions lead through fixed strainers to centrifugal circulating pumps (motor driven), which discharge through slowly rotating self-cleaning strainers, and thence to the condensers.

The return water from the condensers passes again through the rotary strainers washing out any material caught in the latter.

The pipe lines are laid under the pier structure, which extends about 118 ft. 6 in. into the river, and continue a further 108 ft. into the river bed.

The main switchgear occupies two galleries on the opposite side of the engine room from the boiler house. It is of the oil-break remote-controlled electrically-operated type, supplied by the British Westinghouse Co., and provides for the completed station equipment of eight generators and 32 feeders; each generator is coupled to four feeders, and through isolating switches to the main bus-bars. The oil switches, of Westinghouse standard type encased in brickwork, are situated on the top gallery; the operating switchgear on the lower gallery, includes a bench with control switches and indicating lamps, and instrument panels above.

Behind the control gear is situated the auxiliary switchboard for operating the station lighting, motors, auxiliary plant, &c., and certain local d.c. tramway feeders.

Two groups of feeders leave the building through tunnels, one supplying the north of London *via* the Blackwall Tunnel, and the other the southern tramways.

For supplying local tramway routes, a sub-station containing three 500-KW. Dick-Kerr motor-generators has been equipped near the switchboard recess, and a 280-cell Tudor battery is provided in the basement for use in conjunction with the sub-station plant.

Other sub-stations have been provided at Clapham, Streatham, Brixton Road, Elephant and Castle, Camberwell and New Cross, and several more are under construction. Details of these sub-stations and of the Council's tramways have already appeared in the ELECTRICAL REVIEW.

The engineering details of the Greenwich station are due to Mr. J. H. Rider, the Council's tramways electrical engineer, and the equipment has been carried out under the supervision of that gentleman and Mr. A. L. C. Fell, the Council's chief officer of tramways.

The present building contains 14,000 KW. of plant: the second portion, in which it is proposed to use turbo-generators, will contain 20,000 KW., making 34,000 KW. for the completed station, which is estimated to cost some £900,000.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Neutralised Repulsion Motor.

The first two points I raised may now be considered as settled: Mr. Cramp's promise as to the third point is of the fairest, and I will wait.

As to the fourth point, I maintain that I am absolutely right, and Mr. Cramp's diagram, when correctly interpreted, proves me to be so. It is evident that Mr. Cramp has entirely failed to grasp the point of my fourth contention. I suggested that the torque could only be large if the power-factor was bad, that is, if o c lagged considerably behind o e. Let Mr. Cramp give at least one reason why I am "entirely wrong"—the mere fact of his saying so makes no impression on me whatever.

Mr. Cramp flatters himself when he thinks he has disproved my fifth point. I am always ready to admit any mistake I may make, however small it may be. In this instance I admitted that in my hypothetical case a *small* torque would still be available, *i.e.*, a torque proportional to a *small* percentage of the total motor field; of course, if Mr. Cramp admits that he relies for the operation of his motor on a torque of that order, then he must also admit my main contention to the effect that the weight efficiency of his motor is so small as to make it useless for all practical purposes. More was claimed for the machine at first, since this motor was brought to the fore during a discussion on railway motors, and placed alongside well-known forms of motors as being quite able to bear comparison with them. I failed to see how such a motor could lay claim to any of the advantages which it was supposed to possess, hence this correspondence.

If Mr. Cramp knew, *before* I pointed it out to him, that my hypothesis was most improbable, why did he not say so, and why did he go to the trouble of constructing the diagram in his letter of May 5th? I fancy that he was distinctly under the impression at the time that his diagram really represented the true conditions in his motor.

My next contention Mr. Cramp treats as "obviously absurd." Of course, he is perfectly at liberty to put it in that way if he likes, but a statement of that kind carries no weight in itself, and can only be considered really crushing if it is backed by some sound argument. For that argument I have looked in vain in Mr. Cramp's letter. All he says in support of it amounts to this:—"I have taken the trouble to construct a certain diagram; consequently the various fluxes, E.M.F.'s and currents in my motor *must* follow the lines indicated by that diagram regardless of all natural laws." The total transformer flux due to E *must* pass through limb 3 at the risk of Mr. Cramp's displeasure, and if some of it does venture *viâ* limb 2, it must at once alter its phase, for, if it did not, no torque to speak of would result at high power factors, and that would be inconvenient! I do not think that anybody will blame me for refusing to be convinced by any such argument. I have questioned the correctness of these very assumptions in Mr. Cramp's diagram, and the first thing for him to do is to confute the arguments I then put forward. In my last letter I said, amongst other things:—"Although Mr. Cramp does not seem to think so, yet the greater part of o ϕ passes through the armature from F to F, as well as part of the leakage flux." This contention I have supported by a lengthy and, I think, a sound argument.

In the next paragraph we have the same story over again. I am told that my conclusions are misleading; but *why* are they so? Let Mr. Cramp point out my mistakes, if he can do so. I am not in the least concerned with what Mr. Eborall or anybody else said about polyphase motors, nor do I care one jot whether my arguments apply to other motors besides the one I am dealing with. I am at present concerned with nothing but Mr. Cramp's motor, and this apparently does not suit Mr. Cramp.

I understood Mr. Cramp to say just now that the case illustrated by his diagram was hypothetical and most improbable, yet he offers to admit that he is in error if I can prove that for that particular hypothetical and most improbable case $\phi\ \phi_1$ is not the motor field. I fail to follow the logic of such an offer, but I am prepared to show that $\phi\ \phi_1$ is not the only flux passing from F to F, and that, therefore, it is not the motor field, but only a small component of that field. I have, in fact, proved this very point in my last letter; I hold that o ϕ must be looked upon as the whole of the transformer flux, and a great part of that flux will undoubtedly pass from F to F whilst the remaining part will thread coil B. (With the likely proportions of these two parts of the transformer flux I have fully dealt in my last letter.) The motor field, therefore, has two components, the greater of the same phase as o ϕ, and the smaller of about the same phase as $\phi\ \phi_1$.

It has been my desire from the first to hear from Mr. Cramp how his motor operates according to his views. I have stated mine on the subject, and will continue to hold them until Mr. Cramp can prove them to be wrong. If Mr. Cramp cannot state the theory of his motor now, I must wait until he can do so, and I hope he will at the same time give us the data I asked for in my last letter. I have failed to grasp the meaning of lines 3 to 8 from bottom of his letter, and therefore cannot comment on them.

Val. A. Fynn.

London, S.E., *May 26th*, 1906.

The Efficiencies of D.C. and A.C. Motors.

On p. 377 of the April, 1906, issue of the *Journal* of the Institution of Electrical Engineers, in Mr. Fynn's (revised) reply to the discussion of his paper entitled "A New Single-phase Commutator Motor," occurs the following statement:—"I cannot agree that the efficiency of an ordinary commercial continuous-current motor of 6 B.H.P. is anything like 84 per cent.; it is much nearer 75 per cent."

On p. 371 of Mr. Mordey's (revised) contribution to the discussion on Mr. Fynn's paper, he states that he doubts "whether the commercial continuous-current 6-H.P. motor has over 75 per cent. efficiency." Mr. Mordey alludes to a 6-H.P. Fynn single-phase 50-cycle four-pole motor tested at the Alioth Co.'s works at Basle on January 12th, 1906, as having 67 per cent. efficiency at its rated load. If, as I believe, a fair corresponding figure for the ordinary 6-H.P. continuous-current motor is 84 per cent., then, obviously, the loss in the single-phase motor is $\frac{100-67}{100-84} = \frac{33}{16} =$ over twice that in the continuous current motor.

It is in many cases not the loss in the motor that counts, but the cost of the motor. If the motors compared are to have the same temperature rise, then assuming equally careful design, the motor with over twice the loss must have nearly twice the weight, and at least one and one-half times the cost.

The single-phase motor has a perfectly legitimate and important field of usefulness. In defining the extent of this legitimate field, it is important to know the ratio of the costs of the two types of motor. This, as I have explained, is

largely dependent upon the ratio of the weights. The ratio of the weights follows quite closely the ratio of the losses. The ratio of the losses is readily derived from the efficiencies as shown. This may sound exceedingly elementary after the recent deluge of circle diagrams, but strange as it may seem, the importance of this point of view is not yet clearly comprehended.

I should be pleased if the question of the efficiencies and weights of the two types of motors could be the subject of correspondence. It should not be necessary for me to bring out more of my data, as I have published it very liberally. Messrs. Mordey and Fynn have also submitted their data. The further data should therefore come from other sources. At present the published data stands as follows :—

	Commercial efficiency of representative open protected type, moderate speed, 6-H.P. motor.	
	Single-phase.	Continuous-current.
Mordey and Fynn...	67 %	75 %
Writer	—	84 %
Others	?	?
,, ...	?	?
,, ...	?	?
,, ...	?	?
,, ...	?	?

Data of the corresponding weights, speeds, voltages and temperature rise, would also affect the comparison and should preferably be included.

It may be that Messrs. Mordey and Fynn intended their estimate of 75 per cent. efficiency for a 6-H.P. continuous current motor to apply to their own particular designs. In that case, however, it is not right to quote these figures as representative for the average commercial design. I myself have always had the inclination to design for high efficiency on light loads, which generally involves the sacrifice of 1 or 2 per cent. efficiency at rated full load, and my estimate of 84 per cent. takes this into account. Thus it will be seen that my figure of 84 per cent. is not to be taken to apply to designs of especially high efficiency, and efficiencies of at least this order of magnitude have almost certainly been obtained by innumerable designers. I have on my files the lists of any number of manufacturers for whom I have never done any designing work, and these lists show efficiencies of 84 per cent. or thereabouts for 6-H.P. continuous current motors. It is hardly likely that these manufacturers would list efficiencies 9 per cent. higher than the results obtained in their tests.

Messrs. Mordey and Fynn's position is equivalent to taking the stand that the best electric motors have efficiencies some 9 per cent. lower than generally estimated. Were this the case (but my own experience is that this is not the case), it would be tantamount to placing an additional 9 per cent. handicap on the electric motor as compared with internal combustion motors, the competition with which is in any event bound to be keen. Hence the importance of getting at the facts.

H. M. Hobart.

London, W.C., *May 25th*, 1906.

Preferential Rates.

I am pleased "Contractor" has taken up this matter, as I am being treated in the same way in every respect.

If contractors do not get the best prices, it is impossible for them to quote as low as they could were they given the lowest possible figure.

I have drawn several customers', architects' and consulting engineers' attention to this fact, and find I have their support against such unfair treatment, as I have been told to get best value possible, and not pay outside prices. If railway companies, private works, shipping companies and corporations get preferential rates, it is time for contractors, who are supposed to get equal prices, and should get even better, to find another firm to purchase from.

Trusting the Manufacturers' and Contractors' Associations will give this matter attention—

Another Contractor.

Day Load for Small Central Stations.

It is a generally admitted fact that the supply of electricity to small towns on a paying basis is beset with difficulties. Increasing the earning capacity of the plant by *providing* a day load for it would in a great measure remove these difficulties. A motor load being out of the question, some manufacturing process has to be carried out on the premises. This plan has been successfully adopted in a few small stations, one of which derives nearly half its revenue from making ice for local creameries, which being mostly a summer load suits admirably. A saw mill attached to another station keeps the plant earning money all day; a stone breaker answers the same purpose at a third. In a fourth station, the steam plant is utilised in the daytime for testing high-speed engines for a neighbouring builder.

An electro-chemical process would form an ideal load, especially where water-power is available—to which apparently little attention has been devoted.

If your readers could be induced to give particulars of their experiences in this matter it would open an interesting field for enterprise.

£ s. d.

Separation of Oil from Feed Water.

Your correspondent "Onlooker," in last week's issue drew attention to the importance of even an exceedingly small percentage of oil remaining unextracted from boiler feed water. I quite agree with him in respect to this, and that any method of oil separation from feed water based on mechanically separating it out when combined with exhaust steam, is not as a rule satisfactory, as a percentage such as he mentions often remains unextracted.

In Mr. Harwood's article of April 13th several methods of oil extraction were given, but there is one which was not mentioned, and which may be of interest to refer to.

I have to deal with the exhaust from several types of engines, some being Willans, where the amount of oil in the exhaust steam is generally more than is normally met with. I have installed a Harris-Anderson water-softening plant, and had it designed for the attachment of extra chemical tanks for the supplying of alumina sulphate in case such should be found necessary for dealing with the oily condensed water.

It is a well-known fact that the deposited lime and chemicals which are thrown down in a state of minute subdivision when hardened water is treated, are capable of mechanically adhering to the emulsified oil and carrying it down along with them. The utility of this method of oil extraction has in our case surpassed my anticipations. Our feed water is drawn from the River Trent, having a hardness varying from 24-28°, and we find that even when the proportion of condensed water containing emulsified oil to hard water, is in the proportion of 4 to 1, the treatment for hardness by caustic soda alone is sufficient satisfactorily to extract the oil from the condensed water, and give a perfectly clear resultant liquid. The Harris-Anderson plant, when dealing entirely with hard water, reduces the hardness to about 6 or 7°, and as an instance of how satisfactorily this plant is working, both from a water-softening and extraction of oil point of view, I might say that the boiler inspectors have remarked several times that they have never seen boilers in better condition.

P. J. Pringle.

Burton-upon-Trent, *May 29th*, 1906.

I have followed with interest the correspondence on the question of the separation of oil from feed water, and as I have devoted some attention to the matter, my experience may be of interest to others.

We originally installed a chemical filter in our boiler house to deal with the water delivered by the condenser force pump on its way to the hot well. This filter was one of a well-known make, using alumina ferric as the coagulent. While it certainly did intercept a large quantity of oil, I felt sure that some was still passing into our boilers. I also found that the filter required a very great deal of attention, the filter bed quickly becoming clogged.

I, therefore, arranged to place a baffle separator in the main exhaust. This filter was partly made in our works to our own designs—nothing whatever novel in it. We pump the oily water which collects in the separator chamber into large settling tanks in the engine room. In these tanks a considerable quantity of the oil comes to the surface, which is periodically skimmed off and twice filtered before it is again used for cylinder lubrication. In this way we recover on an average about 60 per cent. of the oil used, and last year made a total saving in oil so recovered, of £46. The chemical filter is now our "second line of defence," and under these conditions works very efficiently in removing the last trace of oil from the water.

I fear there are many central station engineers who do not realise the risk and serious consequences of allowing even a minute quantity of oil to find its way into high-pressure boilers. My experience certainly confirms my opinion that one should remove all the oil possible before the steam enters the condenser (to let oil get on condenser tubes greatly impairs their efficiency), and that the process of oil elimination should be completed by a chemical filter after the steam has been condensed. The resultant longer life which the boilers will have, and the smaller repair bill, will amply repay the cost of the duplicate system.

Frank Ayton.

Ipswich, *May 25th*, 1906.

LEGAL.

Plea of Infancy Fails.

In the Shoreditch County Court, on Friday, May 25th, before his Honour Judge Smyly, K.C., the General Incandescent Co., of 52, Great Eastern Street, E.C., manufacturers of gas fittings, &c., sued Messrs. A. Harris & Co., of 302, King Street, Hammersmith, dealers in electrical and gas fittings, to recover the sum of £16 13s. 4d. for gas and electrical fittings supplied. Mr. Harold Brandon appeared as counsel for the plaintiffs and Mr. Percy for defendants.

In opening the case, Mr. Brandon said he was placed in an awkward position. The only gentleman they had known in connection with the defendants' business they had seen outside the Court that day, but he now denied that he had anything to do with it, and they were therefore left with a little curly-headed boy, who said he was the company and was an infant.

This youth was called. In answer to questions he said he ran the business as A. Harris & Co., he being Alfred Harris, and that he had a branch at Dunoon, in Scotland. For the looking after the business he had employed managers. He was sorry to say that now the bailiffs were in for rent, and that he had nothing. In defence to the action he was pleading infancy. He was 17½ years of age now.

Mr. Brandon: What are you and where were you born?

His Honour: He cannot very well say that, it must be only hearsay evidence.

Defendant: I am a Pole, and was born at Warsaw.

His Honour: Only his mother can prove that, and she must in English law produce a certificate of his birth to prove it.

Witness said that he had no fixed abode, but lived with his mother at 40, Abinger Road, Bedford Park, when in town. His father had done no work for some time. He really had no idea who paid the rent of the fashionably furnished house at Bedford Park, but he knew that in his time he had paid some very considerable sums of money to his family. He now had no money or banking account. His father was not his salaried servant, and he had no idea what he did for a living.

His Honour: I find that this plea of infancy fails in English law, as no certificate has been produced. There will be judgment for the amount claimed, with costs.

Attorney-General *v.* The Pontypridd U.D.C.

On Wednesday, May 23rd, at the conclusion of the arguments of counsel, the Master of the Rolls, in giving judgment, said two questions were raised for the decision of the Court, partly of fact and partly of law. The first question, which was one of fact, was under what powers did the defendants acquire the piece of land in question, viz., under what statutory powers were the defendants acting when they acquired the site of the dust destructor? Mr. Justice Farwell had found, as a fact, that this land had been acquired under the powers conferred by the Electric Lighting Acts, and with this conclusion of fact, he (the Master of the Rolls) entirely agreed. The next question was, did those Acts give the defendants the right to build and use the dust destructor when built on the land so acquired? If they did, it could only be by virtue of its being necessary and incidental to the supply of electricity; if it was not necessary or incidental to this object, then its construction was *ultra vires* of the statutory powers. That again raised the question whether a dust destructor like this could be considered as "incidental" to electric lighting. Mr. Justice Farwell had come to the conclusion that it was not necessary or incidental to the purposes of electric lighting, but that its construction had been undertaken for the purpose of getting rid of the dust and refuse which the Council were obliged to remove, and not as a necessary adjunct to the main purpose of electric lighting, and consequently that it was *ultra vires* the powers of the Council. He (the Master of the Rolls) was clearly of opinion that from the very first the object of the Council was to acquire this land for tramways and electric lighting purposes, and that the evidence showed conclusively that the dust destructor was not incidental or necessary to the Council's generating scheme at all. He thought the decision of Mr. Justice Farwell was right both on the facts and the law, and that the appeal failed, and should be dismissed with costs.

Lord Justice Romer concurred, but thought the order in the Court below should be varied by making a declaration that the use by the defendants of the part of the land purchased for the erection of a dust destructor, according to the scheme prepared by them, was outside their powers of dealing with it, and ought to be restrained, and then to let the injunction run on in general terms, restraining them from using the land except for the purposes of generating electricity, and generally for all such acts and things as might be necessary and incidental to such supply following the words of Sec. 10 of the Act of 1882.

The Marconi International Marine Communication Co., Ltd., and Another *v.* Lloyd's.

(*Concluded from page* 833.)

The learned counsel (Mr. Warmington, K.C.) proceeding, said the stations with regard to which complaint was particularly directed by his clients were Malin Head, Lizard, North Foreland, Crookhaven, Rosslare and Niton. The contention of his clients was that the British Admiralty were not now, and had not since the date of the agreement been, working wireless telegraphy, and they further submitted that the British Admiralty were not willing to work it. Defendants now said that the Admiralty were willing to do so if what the defendants were pleased to call certain reasonable stipulations were accepted by the plaintiffs. Defendants put it as a condition precedent to the plaintiffs' right that the British Admiralty should be unwilling to work the wireless telegraphy, and said that that implied an obligation on the Marconi Companies' part, not to insist upon any stipulation which Lloyd's might think was unreasonable. He (counsel) demurred to the defence, and said that the facts and imputation upon which it rested really did not exist. The first point in the clause was whether plaintiffs were entitled under the circumstances to take over and control the wireless telegraphy at these particular stations. So far as matters of fact were concerned, they would be proved by witnesses on their behalf and by the correspondence which had passed between the parties. It was from the sea telegraphy that the plaintiffs derived their profit, and that was what they wished to promote. That did not concern Lloyd's, who simply had to hand over the proceeds to the plaintiffs; but so far as the Marconi Companies were concerned, it was a matter of the highest importance, because their revenue in great part depended upon sea telegraphy. Clause 2 showed that the British Admiralty were not willing to work the wireless telegraphy, and that was admitted. They might, of course, become willing to work it, and when they did it would be by reason of the concurrence of the plaintiffs and the defendants; then, no doubt, they would give over to the Admiralty the working of those stations. But the present position was that the Admiralty were not working any station, and that being so, the working by wireless telegraphy was to be, as they submitted, under the control of the present plaintiffs—the Marconi Co. The learned counsel said the facts he had stated as to the Admiralty were borne out by the correspondence.

Mr. Eve said the difficulty was that the Admiralty insisted upon a good deal of the correspondence being confidential.

Mr. Warmington: I ask your Lordship to help us both in this matter. Although the letters are marked confidential, I ask your Lordship to see them. As evidence of willingness or unwillingness it seems to me to rest on the correspondence.

His Lordship: Are you agreed that the British Admiralty are willing to do it on certain terms?

Mr. Warmington: No.

His Lordship: You do not go as far as that?

Mr. Warmington: No, I think not.

His Lordship: Do you say they are unwilling to do it, except on certain terms which you do not see your way to accede to?

Mr. Warmington said that no definite terms had been agreed to by either side. But the Admiralty had said that if the terms insisted upon included a certain term, they were unwilling to agree to it. They had never got so far as discussing positive terms.

Mr. Eve, K.C., said he thought as far as maritime signalling was concerned the Admiralty agreed that they would not get the electricians employed to take over the signalling alone, but they would have to take over the telegraphy too. The Admiralty said that as long as this position was insisted upon by the Marconi Companies, the Government would not go any further.

Mr. Warmington: The point communicated to us was that the Admiralty declined to work sea telegraphy.

Mr. Eve: That is quite inconsistent with the communication made to us, that it would not pay them to keep their electricians employed to take maritime signalling alone. They go further, and said that the two services could not be separated.

Mr. Warmington: Our correspondence shows that the Admiralty were unwilling, and they give us their reason. They said they had decided not to undertake sea telegraphy for the present, but they decided to undertake maritime signalling at stations not yet defined.

Mr. Eve said that he could read letters which showed that that was not the state of things brought to their notice by the Admiralty.

Mr. Warmington said his argument on Clause 2 was that from the moment the Admiralty stated they were unwilling to take over the stations, and until such time as they were willing to do so, the plaintiffs were entitled to work them themselves

His Lordship having read to himself the correspondence which had passed with the Admiralty, the plaintiffs' case closed.

Mr. Eve, K.C., in opening the defendants' case, referred to the terms of the agreement of September 26th, 1901, and said that in 1904 Lloyd's commenced the action which had been referred to, and in which they alleged that they had performed the agreement, and had been willing to undertake and carry out the working, but that the defendants (Marconi's) had refused to allow them so to do. Marconi's, by way of defence to the action, alleged incompetency by the operators of Lloyd's, and by way of counterclaim they claimed a declaration that they were entitled to retain possession, and an injunction to restrain any attempted handing over of the work to the Admiralty. Shortly afterwards, Lloyd's commenced the second action. That was on March 11th, 1905. This action was founded not only upon the agreement of September 26th, 1901, but also upon another agreement made between Lloyd's and Marconi's Wireless Telegraph Co. made on the same day. It was alleged that these two agreements constituted one transaction, and that in breach of the stipulations contained in them a station had been established in Cornwall for the purpose of maritime signalling and sea telegraphy. By way of defence it was denied that the two agreements were really one transaction, and it was also denied that the station at Poldhu had been established wrongfully within the meaning of the said agreement. They further said that the sea messages sent were not within the true meaning of sea telegraphy. The question was whether the station at Poldhu was under the control of the International Co., and whether the agreements of September, 1901, must be read as one transaction. Another point was whether messages sent to steamers were within the definition of the principal agreement, or whether such messages as came from ships only were within the purview of the agreement. In that state of things the position was this: Both parties were asserting their right to work the wireless telegraphy, and each party seemed to have been suspicious of the ability of the other to work that portion of it in which the other was interested. Neither party being willing to concede to the other the possession of the stations, a solution of the difficulty was found by the substitution of some third party in which both should have confidence. By the communication which passed between the Admiralty and Lloyd's in 1904, the former were content to allow the Coastguard officials to undertake maritime signalling and telegraphy. The Admiralty took the view that the Coastguards could undertake the sea telegraphy as well as the signalling. The agreement of 1905 was a concession by both parties. The parties agreed that the difficulty would be got over by putting it into the hands of the Admiralty. The position before his Lordship was that, at the time the conference was held, in January or February, the Marconi Co. had again become suspicious as to whether the Admiralty would give the same consideration to that portion of the wireless telegraphy represented by a commercial undertaking as they would with reference to the movement of ships, including ships of war. By the time the Conference was held, it was clear that the Admiralty had expressed their willingness to take over three out of the five stations then in dispute. The gentleman representing the Marconi Co. gave expression to opinions which were inconsistent with the desire to give effect to the compromise arrived at in the action. It showed that he was not anxious that the matter should be in fact taken over by the Admiralty, but, on the contrary, had a desire to retain possession. And, following that opinion, his Lordship would find the imposition of a condition on the Admiralty. Lloyd's case was that, but for that, the Admiralty would have taken over the stations before now. The only matters on which the parties were to negotiate separately were as to the expenses of working the various stations. Nobody had ever suggested that any difficulty had ever arisen at arriving at the expenses, which each party was to settle with the Admiralty. His instructions were that if the condition were withdrawn there would be no difficulty in the Admiralty taking over the stations. At the conference the Marconi representative's attitude was perfectly candid. He was not prepared to facilitate, but he would not oppose the Admiralty taking the stations. That was not carrying out his agreement. In the settlement there was not, from start to finish, a single concession in favour of Lloyd's, and there were concessions by Lloyd's to Marconi's from beginning to end. He asked his Lordship, on the construction of the agreement and on the matters in issue, to hold that it was not competent for the plaintiffs merely to adopt the position of interposing, but to say that they were bound actively to take steps with Lloyd's in inducing the Admiralty to undertake the working of these particular stations.

Captain A. G. Bethell examined, said he was assistant-director of Naval Ordnance at the Admiralty. He was present at the conference referred to between the representative of the Marconi Co.'s and the representative committee of the Lords of the Admiralty. He was in the chair. The *précis* prepared from the shorthand notes correctly represented what took place at that conference. The Admiralty had not taken over the working of the wireless telegraphy at any of the five stations, the subject matter of this action. That was because they were not in a position to do so. They had not been able to come to terms with the Marconi Co. The company wished to impose a condition on the Admiralty which the Admiralty could not accept. The condition was that if the working, in the opinion of the company, was unsatisfactory, the company was to have the right to work it themselves.

Cross-examined: Nothing was mentioned about new inventions or about the installation of new inventions. The company's managing director said he was advised that the operator coast-guards were not efficient to work the instruments. Witness did not say that was not a matter in which the Marconi Co. were interested. The Admiralty had plenty of competent operators. He thought the Admiralty were to bear the cost of the wages of the operators. Sea telegraphy was entirely a commercial matter. The Admiralty never intended to maintain the commercial part of Marconi. All they undertook to do was to manage the instruments. The commercial part was to be done by a representative of Lloyd's. The Admiralty had never any intention of taking over the commercial business. The point was as to who was to be the judge of the efficient working. Marconi's representative said they were to be. Witness did not care to take it on that condition.

Have you ever suggested any course to the Marconi people which would secure to them the satisfactory working of the sea telegraphy?—We have not; we dropped the matter after that.

Mr. Thos. Devereux, examined, said he was head of the signal department at Lloyd's, and as such all matters with regard to wireless te'egraphy came under his notice. At the date of the compromise they were actually in possession, and working the five stations, and remained so ever since. At the stations no books of accounts were kept. A message coming from a steamer to the station was paid for on the steamer, and when received at the station was dealt with by the operator and passed on to the postal telegraph wire to the addressee. Outward messages to steamers were paid for by the person who sent them at the post office. There were various forms of clerical work which had to be done at the station.

Cross-examined: He was not a skilled electrician.

Has not a record to be kept of every wave which is received from the apparatus, and the date of it?—Not on the forms sent to our men to fill up.

Do you not enter the moment you get into contact—say at the land station with the ship?—Yes.

And the moment you lose contact?—Yes.

Further cross-examined: The apparatus did require good manipulation, and both skill and knowledge.

Mr. James and Mr. Warmington addressed the jury on behalf of their respective clients.

His Lordship gave judgment as follows: In this case the Marconi International Co. and the Marconi Wireless Telegraph Co. are the plaintiffs and Lloyd's are the defendants, and it will be convenient to refer to the plantiffs as the Marconi Companies. Their object is to obtain a decision as to the true construction of two agreements entered into with the defendants, and a declaration that in the events which have happened, the Marconi Companies are entitled to take over the control of the working of the wireless telegraphy at Crookhaven, Malin Head, the Lizard, Niton, and the North Foreland. There was a sixth station as to which the same question arose, but it has dropped out, the companies having obtained possession. Now it appears that on Sept. 26th, 1901, an agreement was entered into between one of the Marconi Companies—the International—and Lloyd's, and that for certain considerations that company granted to Lloyd's the right or licence to use and work for the sole purpose of maritime signalling at all or any of Lloyd's signal stations already established, or thereafter to be established, during the currency of the agreement of the Marconi system of wireless telegraphy, and any patents or inventions in connection therewith, and there were provisions as to the provision and installation of apparatus, and as to payment of royalty. After quoting Clause 9 (see Elec. Rev., May 25th, p. 833), his Lordship said that the result of the agreement was that the stations were to be worked by Lloyd's, the profit from the sea telegraphy went to the Marconi Companies, and the benefit of the maritime signalling went to Lloyds. This agreement and another agreement of even date entered into between Lloyd's and the other Marconi Co. led to litigation. One action was brought by Lloyd's against the Marconi International Co., in which Lloyd's alleged that they were ready and willing to perform their part of the agreement, but that the defendants refused to permit Lloyd's to work wireless telegraphy at certain stations. The company put in a defence, in which they alleged breaches by Lloyd's of the agreement with regard to the working. Then there was a second action brought by Lloyd's, particularly with reference to the Poldhu station, alleging that the Poldhu station was not restricted to wireless telegraphy from shore to shore, but was being used for transmitting sea messages within the meaning of the other agreement. The actions were set down for trial, and an agreement was come to between counsel. An order was made by the judge that all further proceedings in both actions, and a counter-claim in one of the actions, be stayed upon terms initialed by Mr. Lawrence and Mr. Warmington, the respective counsel for plaintiffs and defendants in those actions. The terms so initialed constitute the second agreement sued upon in this action, and the real question is what is the proper construction of the terms so agreed upon. The terms agreed were for certain additions to and modifications of the original agreement of September 26th, 1901, and except so far as modified by the provisions of this agreement in the nature of a supplementary agreement, the principal agreement was to continue in force. The terms also provided for the principal agreement being re-drafted to embody the modifications, and there was also a provision for referring it to counsel to settle in the case of difference. No fresh agreement has actually been drafted, and the matter has been allowed to remain upon the terms so initialed. The principal clauses are 1 and 2. Clause 1 provides for the defendants concurring with Lloyd's in arranging for the British Admiralty, if willing, to work wireless telegraphy for the purpose both of maritime signalling and sea telegraphy at all stations in the United Kingdom or abroad, whether defendants' or Lloyd's, at which now or hereafter Marconi's system for maritime purposes is used, and the defendants were to be at liberty to arrange with

the British Admiralty payments to be made for the purpose of sea telegraphy, and Lloyd's were to be at liberty to arrange with the British Admiralty for payments to be made for the expense of working the stations for the purpose of maritime signalling. Clause 2 provides that all such stations in the United Kingdom or abroad at which the British Admiralty were unwilling to work the wireless telegraphy, and at which sea telegraphy shall for the time being be practised, the working of wireless telegraphy to be under the control of defendants or either of them, if and so long as they so desire, and if not then to be done by Lloyd's on reasonable notice. In case of any complaint by the defendants as to the alleged inefficiency of working at any station at which wireless telegraphy is worked by Lloyd's, the sole remedy of the defendants, the Marconi Companies, is to be to take over the working of the wireless telegraphy themselves at such station, and not to sue for damages. It is alleged by the Marconi Companies that at the five stations in dispute—and certainly details have been given with regard to one—that the working by Lloyd's has been inefficient, and it has been pointed out that according to the provisions of Clause 2 the Marconi Companies are entitled to take over the working in case of any complaint by them as to alleged inefficiency of working at any station. It was conceded by Lloyd's—in fact, they could not contend otherwise—that the Marconi Companies had from time to time alleged inefficiency at one or more stations, and that the allegations were made in good faith. It was said that in regard to many of the cases some answer could be given. Perhaps some of the complaints were want of skill or diligence, and the others carelessness, but it appears to be clear that the real question at issue, was not whether in any respect the working at any particular station was inefficient, but whether any *bonâ fide* or reasonable complaints had been made by the defendants, as to the alleged inefficiency, and whether defendants' allegations of inefficiency were made in good faith. Lloyd's said they were unable to contest that, and that dispenses with quite a considerable body of evidence. It does appear from the wireless journals to which references were made, that there were many instances of machines going wrong, of jumbled messages going through, and so forth. A very careful perusal shows that it occurred. You cannot consider any details of inefficiency. It is enough to say that the Marconi Companies had reasonable ground for complaint, and *bonâ fide* complaint of the inefficiency of Lloyd's working. It is not necessary for the plaintiffs' case to put it higher, and as against the defendants it ought not to be put higher, because both sides have abstained from going into evidence on the matter. In those circumstances the Marconi Companies claim that the event has happened under which they are entitled to take over the working of the wireless telegraphy themselves. They have no claim for damages for breach of the agreement in this respect. Such a claim is excluded. The agreement says that the sole remedy of the Marconi Companies is to take over the working themselves, and they claim to take it over. In opposition to that claim, it is said on behalf of Lloyd's that the Marconi Companies are only enabled under the supplemental agreement to take over the stations if the British Admiralty are unwilling to work the wireless telegraphy. That is a condition precedent. Unless and until it is shown that the British Admiralty are unwilling to work the wireless telegraphy, the Marconi Companies, it is said, have no right to take over. It is further urged that both parties, by the supplemental agreement, agreed that the Admiralty were to work the stations; that the only matter left open for arrangement with the Admiralty was as to the working expenses, and that the reason why the Admiralty had signified their unwillingness to work the wireless telegraphy was because of a term insisted upon by the Marconi Companies—one to which the Admiralty were unable to agree. It was said that this alone prevented the Admiralty from making arrangements to work these stations. When the matter is looked into a little closer, it appears to me there is no foundation for that argument, either as matter for construction of the supplemental agreement, or having regard to the facts, and circumstances and what has actually taken place since the date of the agreement. Clause 1 contains a provision that the Marconi Companies are to confer with Lloyd's in arranging for the British Admiralty if willing to work the wireless telegraphy. So that both parties were to make the arrangement, Lloyd's were to make their arrangement for payment of the expenses of working the stations for maritime signalling, and the Marconi Co. was to have its arrangement for explaining as to payments for the purpose of the sea telegraphy. What took place was this: After the agreement was entered into a letter was written, dated December 20th, 1905, from the Admiralty to the managing director of the Marconi Companies. It was in these terms: "Before undertaking any sea telegraphy in the United Kingdom, their Lordships would be glad to learn, as soon as convenient, of the companies' views as to which stations should be selected for carrying out this work, and also to receive their proposals as regards payment to the Admiralty for these services, together with any general remarks which they might have to offer." It was not that the Admiralty were to take all stations or none, for the first question which arose was as to which stations were to be taken over. In answer to that letter, the Marconi Companies' managing director wrote on Dec. 22nd: "I would suggest, as to the questions raised, they should be discussed at an interview as a preliminary to formal proposals in writing." A meeting was arranged, and took place between certain representatives of the Admiralty and the managing director of the Marconi Co. on January 12th of the present year. It was merely a preliminary discussion in order that each side might become possessed of the views of the other. A suggestion was made by Mr. Hall, the managing director of the Marconi Co., that the company should retain their right of taking over the working in case of complaints. This was not acceded to by the Admiralty, but was left for further discussion. Nothing more was heard until February 9th, when a letter was written stating that the Lords of the Admiralty had decided not to take over the stations. No reason was given; nothing was said about Mr. Hall's proposal; the companies were never asked to waive the stipulation; nor do I find any trace of that insistence which was referred to by counsel for the defence. There appears to have been another difficulty which the Admiralty felt as to working sea telegraphy and maritime signalling together, and this may at least be supposed to have had an equal share in prompting their refusal. Captain Bethell has said in his evidence before me that at the meeting there were many matters left for future consideration. On this evidence I am unable to come to the conclusion that it was owing to this particular stipulation that the Admiralty declined. I only know that they did decline. I express no opinion as to the wisdom of the stipulation. The second agreement contains a provision for a new agreement being drawn up, and the original agreement has a provision for arbitration. So if there was any question between Lloyd's and the Marconi Companies as to the time on which the Admiralty should be asked to take over the stations, they could have gone to arbitration. At present I am confronted with this, that there has been an informal conference, and a simple announcement that the Admiralty is unwilling to take over the stations. I make the declaration in the terms asked, and the costs must follow the event.

Fourteen days' stay was granted to enable the defendants to consider whether they would appeal to the House of Lords.

ELECTROLYTIC COPPER.

BY LAWRENCE ADDICKS.

(Abstract of a Paper read before the Electrical Section of the Franklin Institute.)

THE ideal electrolyte for refining copper would be one chemically inert as a solvent, but capable of electro-chemically dissolving copper, and of zero specific resistance. These conditions are most nearly met by an acidulated sulphate solution, and this has the additional commercial advantage of employing one of the cheapest of chemicals, sulphuric acid. A sufficiently high percentage of sulphuric acid may be carried to make the specific resistance very low. There is a slight re-dissolving of the cathode copper, but not in serious amount. Gold is untouched, and silver practically so. It is customary to carry a minute percentage of some soluble chloride as a constituent of the electrolyte which would throw down as chloride any silver which might be dissolved, and also tend to slime antimony as oxychloride. Some claim that smoother cathodes result from the presence of chlorine. While the actual benefits from this ingredient are open to question, it certainly does no harm, and the refiner is often morally sustained by its presence.

In American refineries high grade anodes are universally used. Usual compositions are:—

Copper	98 to 99·5 per cent.
Silver	0 to 300 oz. per ton.
Gold	0 to 40 oz. per ton.
Arsenic	0 to 2 per cent.

Small amounts of antimony, bismuth, iron, nickel, sulphur, tellurium, and silicon.

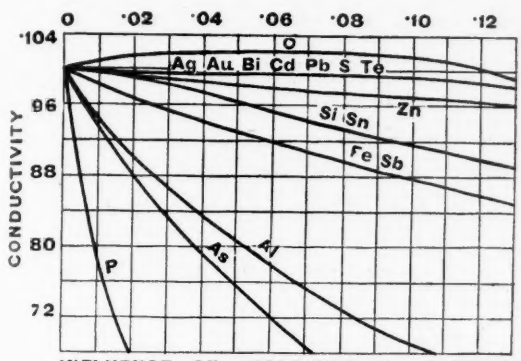
Impurities with soluble sulphates go entirely into solution and grow cumulatively. Selenium and tellurium and the precious metals go entirely into the slimes. We have, therefore, a triple separation. The usual products are only copper at the cathode, silver and gold from the slimes, and sometimes copper and nickel sulphates from the electrolyte. Selenium and tellurium, especially the latter, are easily recoverable from the slimes where there is a sufficient market. Tellurium is an element almost without use in the arts. Small amounts are used in medicine, but the output of one of our copper refineries for one day would stock a large chemical supply house with tellurium enough to last a year. Arsenic, antimony and bismuth go partly into solution, partly into slime, depending on the nature of the form of combination in which they exist in the anode, and various secondary reactions taking place in the electrolyte.

Arsenic is the most difficult impurity with which to deal. If much is present in the anode, say, over 1 per cent., it rapidly grows in the solution and necessitates a large expenditure for purifying to hold it down. With small quantities it seems to slime more rapidly, and no purifying at all is necessary. With other conditions properly cared for, satisfactory cathodes can be produced in an electrolyte running 2 per cent. arsenic, though this is considerably above the customary figure.

The purification of solutions is almost always done by working up a certain quantity regularly into bluestone and adding fresh acid to the electrolyte. If the purification requirement is heavy, the bluestone department becomes disproportionately large, and consequently copper running high in arsenic is most unwelcome. Antimony and bismuth are seldom present in sufficient quantity to cause trouble. Various chemical methods of purification have been tried with the object of regenerating the electrolyte and returning it to the circulation, but there are few substances that will precipitate arsenic in an acid solution, and further, the action of such reagents does not seem reliable, probably due to differences in form of arsenic compounds present at different times. For example, the

writer has boiled electrolytes running high in arsenic with metastannic acid, and obtained a remarkable cleansing action, and, upon other trials, found hardly any precipitation.

The cathode copper is exceedingly pure, usually running about 99·93 per cent. copper, with hydrogen as the chief impurity. Objectionable cathode impurities are of two classes—those which depress the electrical conductivity and those which make the metal brittle. Arsenic and antimony represent the first class; tellurium and lead the second. Good cathode copper should show but a few thousandths of 1 per cent. of arsenic and antimony. The writer's experiments have indicated that it takes but 0·0013 per cent. of arsenic or 0·0071 per cent. of antimony to lower the conductivity 1 per cent. Any conductivity troubles in electrolytic copper can almost invariably be traced to the presence of undue amounts of one or both of these elements. Impurities of the brittle-making class are very rarely met with, and if present, are due to mechanical contamination of the cathode, either in the bath or in the subsequent furnace treatment. A third class of cathode



INFLUENCE OF IMPURITIES ON ELECTRIC CONDUCTIVITY OF COPPER.

impurity concerns the refiner, comprising silver and gold. Cathodes usually show from one-tenth to 1 oz. of silver and a trace of gold. This seems to be due entirely to the mechanical fouling of the cathode by particles of anode slime. In fact, it is a question if most of the arsenic and antimony found in the cathodes does not have a similar origin. The slime is very finely divided, and the continual circulation of the electrolyte necessary to prevent polarisation maintains a very slight turpidity. These particles are probably electrostatically attracted to the cathode. The diagram above shows in a general way the effect of various impurities on the electrical conductivity of copper.

A net current efficiency of from 90 to 95 per cent. can be obtained if care is taken to insulate the tanks from the supporting piers, and if the pipes conveying the electrolyte from tank to tank are of an insulating material such as rubber, and short circuits between electrodes will account for a much greater loss. Other losses in efficiency may be attributed to the re-dissolving of the cathodes, which occur chiefly at the surface of the bath.

The voltage at the switchboard required to force the current through the tanks depends, of course, upon the resistance; this is made up of metallic resistances, liquid resistances, constant resistance and counter E.M.F., the relative values of each in practice being as follows:—

Metallic resistance	15 per cent.
Electrolyte, including transfer	60 ,,
Contacts	20 ,,
C.E.M.F.	5 ,,
	100 per cent.

The question of current density is largely one of power cost; present American practice runs all the way from 12 to 35 amperes per sq. ft. The steady full load on a large power house gives ideal conditions for the generation of cheap steam power. With high current density the tank room requires much closer supervision, as there is a greatly increased tendency toward polarisation. It is customary to circulate the electrolyte from tank to tank to maintain uniform composition throughout. If this were not done the heavy liquor from the surface of the anode would form a horizontal layer of increased specific gravity at the bottom of the tank. Different strata would then have different conductivities, crystals of blue vitriol would form on the bottom edge of the electrodes, and the operation of the tank be thoroughly disorganised. The higher the current density, the greater this tendency, and the more active must be the circulation. An excessive circulation tends to stir up the silver mud, and results in an increased silver loss in the cathodes. It is safe to say that, roughly, the silver contents of the cathodes made at a density of 30 amperes per sq. ft. will be double that of cathodes made at half the density. High-current density also means rougher deposition, and necessitates more frequent renewal of the cathodes to maintain the current efficiency. Most of the Eastern refineries run at from 17 to 20 amperes per sq. ft.

Various "dopes" have been tried for controlling the character of a deposit. Ammonium sulphate undoubtedly exerts a beneficial effect in encouraging smooth deposits. This may be due to some secondary cathode reaction in which the ammonium radicle is momentarily freed. Ammonium sulphate increases the resistance of the solution, however, by driving back the dissociation of the free sulphuric acid present. Organic reducing agents, notably gelatin, have a marked effect in restraining the crystalline nature of deposits, but are not easily controlled in copper solutions. The peculiar structures sometimes seen at the cathode are, doubtless, due to the effect of various soluble impurities in the anode. Often a total change in the character of a deposit can be induced by simply lowering or raising the temperature of the electrolyte.

This paper has been written from the point of view of the multiple system of refining. The main points of difference between this system and the series system are in power cost, compactness and cost of preparing anodes. The power required is practically half as much again in the multiple tank. The series tank has relatively no contacts or conducting bars, and the electrodes are very close together, the anodes being thin even plates. To produce such anodes they must be either rolled or specially hand-cast, and the grade of material used must be good. The interest on the metal tied up in process and on the investment in plant is less in the series system. The series system requires no starting sheets, but much closer supervision to keep the quality of the cathodes up. As lead-lined tanks cannot be used in series work, due to the relatively high voltages used, tank maintenance becomes an important item. The fact that large refineries on both systems are being satisfactorily operated bears witness to the close balancing of the pros and cons in each case, although much more material is refined by the multiple than by the series process.

The paper also discusses the effect of variations in chemical composition and temperature upon the liquid resistance of the cells, and contains a short note on the treatment of electrolyte copper in reverberatory furnaces.

OUR FOREIGN VISITORS.

The Secretary of the Institution of Electrical Engineers has prepared a full programme of arrangements (subject to alterations) for the visit of foreign institutions, from which we extract the following list:—

Headquarters: Hotel Cecil, London.

Saturday and Sunday, June 23rd and 24th.—Guests arrive and register.

Monday, June 25th.—Opening of the Electro-Technical Laboratories of the National Physical Laboratory, by Mr. R. B. Haldane, M.P., Secretary for War.

7 p.m.—Reception and banquet at Hotel Cecil.

Tuesday, June 26th.—Party divides into groups to visit (*a*) G.P.O. telegraphs and telephones, and London Wall Exchange of N.T. Co.; (*b*) L.C.C. generating station at Greenwich; (*c*) Bow Station of the Charing Cross Co.; (*d*) Lot's Road, Chelsea, power station; (*e*) Shepherd's Bush power station of Central London Railway.

9 p.m.—Reception and conversazione at South Kensington.

Wednesday, June 27th.—Excursion to Windsor.

Thursday, June 28th.—Circular tour commences. Stratford-on-Avon; Rugby (B.T.-H. Co.'s and Willans & Robinson's works); Birmingham (Belliss & Morcom's works, Summer Lane electricity station, and the works of the Metropolitan Amalgamated Carriage and Wagon Co., Wolseley Tool and Motor Co. and Elkington & Co.); luncheon at Grand Hotel; University Buildings; General Electric Co.'s works at Witton; Birmingham Small Arms Co.'s works at Sparkbrook.

Friday, June 29th.—Manchester Corporation electricity works; British Westinghouse works; Ship Canal works; reception and conversazione at Victoria University.

Saturday, June 30th.—Liverpool. Lister Drive power station; Dingle Station (Liverpool Overhead Railway); L. & Y. Electric Railway and power station.

Sunday, July 1st.—Windermere.

Monday, July 2nd.—Glasgow (Pinkston and Port Dundas electricity stations); Corporation luncheon; reception by Lord Kelvin at University.

Tuesday, July 3rd.—Works of Babcock & Wilcox at Renfrew; reception and conversazione by Glasgow Corporation.

Wednesday, July 4th.—Edinburgh Corporation luncheon; excursions and visits.

Thursday, July 5th.—Newcastle-on-Tyne; Swan, Hunter and Wigham Richardson's works; Newcastle Electric Supply Co.; Tyne Commissioners' works; North-Eastern Railway (electrical sections).

Friday, July 6th.—Leeds Corporation electricity and tramway stations; works of Greenwood & Batley, and Kitson & Co.; conversazione at Leeds University.

Saturday, July 7th.—Leeds Copper Works; Hunslet Engine Works; Yorkshire Electric Power Co.'s station; excursions; and return to London.

Electric Carriages in Argentine Republic. — No fewer than 50 electric victorias and landaulets have lately been put in service in Buenos Ayres. The vehicles, which are intended for public hire, are on the Krieger system, and are fitted with taxameters.

BUSINESS NOTES.

Automobile Imports.—Mr. J. B. King, the secretary of the British Empire Motor Trades Alliance, writes:—"I notice by the official returns that British motor imports for the first four months of this year (January 1st to April 30th, 1906) amount to the following figures, viz.:—

2,199 motor-cars	£842,620
,, car parts	684,671
805 motor-cycles	22,610
,, cycle parts	9,951
Total value	£1,559,852

This means that the people in this kingdom are this year paying on the average, per month, £389,963; per week, £90,991 7s. 4d.; or per day, £12,998 15s. 4d., for motor goods of foreign manufacture. Our manufacturers should make vigorous efforts to capture the whole of the home trade. The British public should be patriotic enough to demand and buy British motor-vehicles, which are now equal to the best of foreign manufacture, and lastly, British investors should invest in sound British manufacturing concerns connected with the motor trade and thus assist in providing sufficient capital to aid the development of a growing home industry and in finding employment for many thousands more British workmen."

Further Advance in Prices.—At the meeting of the National Electrical Manufacturers' Association (Inc.) held on the 21st ult., it was unanimously resolved—"That, in view of the constant and considerable further rise in the price of raw material that has taken place since December 4th, when an advance of 5 per cent. was instituted, a further advance of 5 per cent. on all electrical goods be enforced, commencing as from June 1st, thus making it a rise of 10 per cent. on all net prices."

Electrical Carriages in Germany.—The Nord Deutsche Automobil und Motoren Gesellschaft is the title of a new company which has been formed at Bremen with the co-operation of the Compagnie Parisienne Electrique (Krieger system), of Paris, the North German Machine Works, of Bremen, and a syndicate headed by the German National Bank, of Bremen. The object of the company is the construction and sale of electrical machinery and apparatus, gas engines and motor-cars of all kinds. The capital of the company is £112,500, and the chairman is Herr G. Plate, president of the North German Lloyd Steamship Co.

Stirling Boiler Contracts.—The Stirling Boiler Co., Ltd., of Motherwell, have just received from the Newcastle-upon-Tyne Electric Supply Co., Ltd., a further large order for a complete boiler house plant, which will be a duplicate of the boiler house now being installed at Carville power station, Wallsend. The company also have in hand further repeat orders for boiler plants for Sheffield Corporation Tramways and Grimsby electricity works, and have received the order for a five boiler plant for Madras Tramways.

Consular Notes.—Spain.—The British Consul at Bilbao in a recent report states that there is now hardly a town or a village in the district, especially when situated in the vicinity of running water, where electric light is not used. A great use has been made during the year of electric motors for small industries and workshops, these replacing in many cases small steam engines. As far as Bilbao is concerned, some further 4,000 H.P. was introduced from Guipuzcoa, whilst 1906 will see some 8,000 H.P. more brought in. Eighty per cent. of the electric plant comes from Germany, the remainder being provided by France and Switzerland. The United States do not compete in this matter, owing to the existence of special agreements between its producers and those of Germany. Owing to the great development in the usage of electricity, native works have been opened in Madrid and in Pampluna for the manufacture of incandescent lamps, whilst Barcelona is undertaking the production of motors and dynamos, but these products are said to be unequal to the foreign imported articles.

Catalogues and Lists.—Messrs. Dyer & Young, Stansted, Essex.—A number of illustrated leaflets in convenient binder introducing to tramway engineers and managers, and the trade also, their specialities in tramway supplies, including controller fingers, tramway motor commutators, car motor brushes, Vitae carbon brushes, gears and pinions.

Messrs. Jno. C. Fuller & Son, Bow.—New abridged list of their stationary and portable accumulators for motor-omnibus, carriage and train lighting purposes, also for house lighting. Prices, sizes and capacity particulars are stated in table form. The different types are illustrated.

The Wilson Wolf Engineering Co., Ltd., Thornton Road, Bradford.—Catalogue describing their continuous-current motors, illustrations of the constituent parts being shown. Tabulated data (and prices) appear concerning small series power motors, open, protected, and totally enclosed, also direct-current dynamos, electric fans for desk, port-hole and other use. We understand that the company make largely to stock for quick delivery.

Messrs. Gent & Co., Ltd., Faraday Works, Leicester.—An 8-pp. pamphlet describing and pricing their "Nugent" inch-by-inch water-level indicator.

Crypto Electrical Co., London, S.E.—Leaflet giving illustrations and prices of fan motors for continuous and alternating currents.

Improved Electric Supplies, Ltd., London, W.C.—Loose list of double trunnion fans for D.C.

Messrs. Reyrolle & Co., Ltd., Hebburn-on-Tyne.—Two new pamphlets. No. 28 gives prices of their house service fuse-boxes, and shows concisely all the several sizes and designs manufactured by them as standard articles. One section of the works is specially equipped for the manufacture of these. No. 29 list gives illustrations and prices of a line of multiple-way ironclad distributing boxes suitable for use in factories, shipyards, on board ships, &c., where a damp-proof and fireproof apparatus is particularly desired. One of the illustrations shows a stamped fuse such as they make for the more convenient working capacities, with the current at which the fuse will blow clearly stamped upon them, so that the risks of an attendant using the wrong-sized fuse are avoided.

Messrs. J. H. Holmes & Co., Newcastle-on-Tyne.—34 pp. art paper list (No. 104) giving names of a number of newspaper and general printing offices, also paper mills, where they have installed electric lighting and power plant. During the last few years they have installed 2,462 dynamos and motors in 293 such establishments, aggregating upwards of 21,330 H.P., in contracts ranging from ¼-H.P. motor to a 1,500-H.P. installation. Many interesting photographic half-tone illustrations appear, showing installations carried out for the *Times*, Messrs. George Newnes, the *Graphic*, *Daily Mirror*, *Daily Mail*, and various other large printing establishments.

The Armorduct Manufacturing Co., Ltd., London, E.C.—New 20-page conduit list (No. C/728) particularising and pricing five grades of conduit, standard, extra heavy, seamless, seamless (extra heavy) and ordinary closed (enamelled and galvanised), also a complete range of conduit fittings. Among the latter we observe the knock-out junction boxes. The list is fully illustrated. We understand that it has been issued to meet immediate needs pending the publication of the larger catalogue, which is to contain many fittings of novel design.

Mr. C. S. Knowles, 7, Victoria Street, S.W.—A number of new leaflets relating to some of the firm's insulating materials. These include the Tenax insulating tape, unglazed porcelain leading-in tubes, the "New Idea" soldering paste, the Eastern battery connector and terminal, and B & D. knobs and cleats for exposed wiring.

Mr. G. Braulik, Upper Thames Street, E.C.—New illustrated catalogue (Section L) of about 130 pp., containing prices and cuts of, and some particulars concerning, a variety of electric light supplies, such variety including main switches and switchboards, special and tumbler switches, ceiling roses, fuses, wall plugs, insulators, conduits and fittings, testing sets, Nernst and other lamps, motors, and so forth.

Holidays.—The London and South-Western Railway Co. have just issued their annual Official Illustrated Holiday Guide and list of apartments, farmhouses, hotels, &c. It contains a description of the numerous health and holiday resorts reached by the line. There is a revised list of golf links, and maps appear on a large sheet, showing not merely the railway, coach, and steamship routes in connection with the general system, but the islands of Jersey and Guernsey and the French coast as far south as Bayonne. Mr. W. T. Perkins is the editor, and the book now makes its eighth appearance.

Destructors Abroad.—Messrs. Meldrum Bros., Ltd., of Timperley, near Manchester, have just secured an order for the equipment of three destructor stations, each having a normal capacity of 100 tons per day of 24 hours. Each station will be fitted with three of their regenerative furnaces, with large boilers of the Babcock & Wilcox type. The aggregate normal capacity of these plants is over 500 tons per diem. They are to be erected on different sites in the City of Paris. Messrs. Meldrum have also secured an order from the municipality of Pretoria, South Africa, comprising one four-grate unit with large boiler, containing buildings, &c.

Book Notices.—*The Practical Testing of Dynamos and Motors.* By C. F. Smith, Wh. Sch. Second edition. Manchester: Scientific Publishing Co. 1906. Price 5s. net.—The early issue of a second edition of this book implies that it has met with a favourable reception. The matter has been thoroughly revised and considerably extended, a number of additional tests having been inserted, and the section dealing with the losses in dynamos and motors has been entirely re-written. While the book is apparently designed primarily for students in technical colleges, it would be erroneous to suppose that its value was confined to these; central station engineers, test-room assistants in manufactories, and many others will find in its pages useful information, not only on the way to carry out the tests, but also on the true meaning of the results, and the best methods of systematically recording them. Incidentally, the theory and characteristic features of the various types of machines dealt with are skilfully summarised. The value of the work would be greatly increased if the testing of large machines were more fully treated; as it is, the testing of combined engine and dynamo sets is dealt with in seven pages. We do not suggest that full directions for engine tests should be given, but the matter is certainly worthy of greater attention. Further, the addition of tables showing the usual efficiencies, &c., of standard dynamos and motors of various outputs, and giving data of use in carrying out the tests, would be an improvement. The book is a good one, and well worth developing in this way.

Parliamentary Companies. By F. N. Keen, barrister-at-law. London: Gee & Co. 1s. net.—This is a pamphlet of some sixty odd pages containing a reprint of a lecture delivered by the author before the Chartered Accountants Students' Society of London, with the object of giving his hearers a rough idea of some of the characteristics presented by Parliamentary companies with which they might be destined to be connected. In discussing the pro-

motion of such undertakings it was necessary to quote at considerable length from different Acts affecting them. The raising of capital moneys by issuing shares, by raising loans, or issuing debenture stocks; the rights of mortgagees; the important question of depreciation and reserve funds; the appropriation of profits; accounts and audit; qualification and remuneration of directors—all these and many other points are briefly covered. The obligations placed upon electric lighting, gas and railway companies are stated.

Die Theorie, Berechnung und Konstruktion der Dampfturbinen. By Gabriel Zahikjanz. Berlin: M. Krayn. Price 6 marks.—This work, as the author states in his preface, is compiled from a series of articles contributed by him to "Die Turbine" during the year 1904-5. It deals exhaustively with the theoretical side of the question, starting from the consideration of the application of pressure to a cylindrical body, and the resultant stresses; and working therefrom to questions of efficiency, construction, theoretical speed, steam pressure, exhaust steam, &c. It concludes with certain fundamental formulæ and examples on which to base practical calculations. To appreciate a work of this kind from a practical rather than a mathematical point of view, it is necessary to take into consideration the fact that, given several years' practical experience of a machine, it is quite possible to construct an example in accordance with certain formulæ evolved during those years of experience, and that the working out of the details towards their most efficient form may be materially assisted by the judicious use of such formulæ.

Business Blue Book. London: Curtis Gardner & Co., Ltd. 2s. net.—A sub-title describes this book as being written for progressive business men and *all* interested in commercial knowledge. Certainly the character of its contents is very varied. For instance, in different chapters one is informed, very briefly, of course, how to start, purchase, develop and sell a business; how to talk business, advertise it, train boys for it, or get a partner; how to patent an invention and sell it; how to read a prospectus and issue one, to insure, to collect debts, to form a business into a company, and a hundred and one other "how to's" that we have not room to enumerate. The writer (or writers) imparts a good deal of interesting general information concerning Lloyd's, and tells you how to act when in financial difficulties (ye gods! Carey Street!)—"how to find the way through"! (Thank heaven!)—how to invest spare capital (when you have any!) how to obtain a partner with capital, and many other things that a lot of men would like to know. We should not like to lead them to believe that by reading these short essays, they are going to "get right there" straight away, but they might here and there pick up a hint or two that would be of value in the conduct of their commercial concerns. Young men just at the commencement of a commercial career would be profited by reading the book.

"Science Abstracts." Sections A and B. Vol. IX, No. 101, May 25th, 1906. London: E. and F. N. Spon, Ltd. 1s. 6d. net each.

"Proceedings of the Engineers' Club of Philadelphia." Vol. XXIII, No. 2, April, 1906. Philadelphia, Pa.: The Club. Quarterly, $2 per annum.

"The Physical Review." Vol. XXII, No. 5, May, 1906. Lancaster, Pa., and London: The Macmillan Co.

"Journal of the Western Society of Engineers." Vol. XI, No. 2, April, 1906. Chicago: The Society. 50 c.

We have been favoured with a bound copy of the eleventh issue of "One and All Gardening," (for 1906), edited by Mr. E. O. Greening.

"The Transactions of the South Yorkshire Association of Mining Students." Vol. I, No. 3, May 1st, 1906. London: The Chichester Press.

The Technical and Scientific Publishing Co., of Milan, intend publishing during the months from now to December a comprehensive work dealing with the more important exhibits of a technical character at the Milan Exhibition. There will be in all 20 parts, the price of which is 20 lire in Italy, and 25 lire posted to foreign countries.

Trolley Wire Ears.—In view of the discussion of Messrs. Tweedy and Dudgeon's paper on overhead equipment regarding the peculiar wear of the trolley wire which occurs mainly at and near the supporting ears, we are asked to call attention to the B.T.-H. flexible trolley wire ear, which is claimed to overcome entirely the effects complained of. Should any tramway engineers desire to test the ears for themselves, the British Thomson-Houston Co., Ltd., will forward a sample for this purpose on application to its Supply Department, Head Office, Rugby.

Brush Contracts.—The Brush Co. has booked the following contracts:—

For the City and South London Railway Co. (per J. H. Tozer & Co.), fifteen steel trailer cars and bogie trucks.

For the Birkdale and District Electric Supply Co., 90-kw. Diesel engine and direct coupled traction dynamo.

Dissolutions and Liquidations. — Havana Electricity Co., Ltd.—This company is winding up voluntarily with Mr. J. T. Claxton as liquidator. Creditors must send the usual particulars by July 6th.

Tramways Extension Syndicate, Ltd.—Creditors must send particulars of their debts, &c., to Mr. Edward Davis, 5, London Wall Buildings, E.C., the liquidator, by June 30th.

The Electric Turbine Gas Retort Charging and Discharging Machine Co., Ltd.—A meeting is to be held at 27, Martin's Lane, E.C., to hear an account of the winding up from the liquidator (Mr. W. K. Wenham).

British Electrical Manufacturing for Abroad.—We extract the following remarks on the electrical engineering trade from the annual report of the Wolverhampton Chamber of Commerce:—"The use of electricity for industrial and traction purposes continues to make great progress, and the volume of electrical machinery manufactured in this country has been considerably greater than in any previous year. South Africa was an important buyer during the first half of the year, but latterly, owing, apparently to the absence of development in the great mining industry, the buying of mining machinery has rather seriously fallen away. Several good orders, however, have been given out for town lighting and traction plants by the various South African Colonies. There has been a moderate demand from Australia and New Zealand, and there is some evidence that these colonies are now more inclined than formerly to place their orders for electrical appliances in this country. It is also gratifying to find that South America is proving a larger buyer of British electrical goods. Unfortunately, the home manufacturing capacity in the heavier branch of the industry is still greater than the demand, with the result that prices continue to fall, and this feature, combined with the dearest copper experienced during recent years, has prevented manufacturers from obtaining anything like an adequate return on the capital employed in their businesses. Several of the larger manufacturers still find it necessary to obtain work for their factories by the promotion of power and kindred electric supply companies, but there are indications that this is a doubtful class of business to enter into, as the several power companies, which have now been at work for a few years, do not appear to be making very good progress. The local concerns are fairly well supplied with orders, but get little satisfaction out of the poor prices ruling."

Belgium.—A company has just been formed in Brussels with a capital of £40,000 and the title La Compagnie Internationale des Lampes Electriques Zircone-Wolfram, to acquire and develop certain patents with regard to incandescent lamps with metal filaments.

The report of the Société des Accumulateurs Tudor, of Brussels, for the last financial year shows a profit of £2,890.

Installation Contracts.—Messrs Edwards and Armstrong, of Bristol, are at present engaged upon the following contracts:—

Ely Paper Mills, Cardiff (for the Lancashire Dynamo and Motor Co.)—Installation of two 160-kw. dynamos, five 60-h.p. motors, three 20-h.p. motors, three 10-h.p. motors, ten 5-h.p. motors, including supply and erection of all necessary main cables, &c.

Bedwellty Union, Tredegar, Mon.—Supply and erection of two 38-b.h.p. steam dynamos, accumulators (400 ampere-hours), 125 cells, one motor pump (direct coupled) with automatic gear.

Somerford Manor, near Chippenham.—Complete electric lighting, including oil engine, accumulators, dynamo, and wiring the manor.

Dulverton Electric Light Co., Dulverton (second contract).—One 55-h.p. turbine, two dynamos, two batteries of accumulators, main switchboard and two miles of mains.

Electric Lifts.—Messrs. A. W. Penrose & Co., Ltd., of Farringdon Road, E.C., have lately completed an electric lift installation at Messrs. Gamage's new building in Holborn Circus. Altogether there are six lifts employed to meet various requirements for goods and passenger service. Two of the lifts were on view last week. One is a "Safety Express" passenger lift, with six speeds ranging from 70 ft. up to 450 ft. per minute. The attendant slowly pushes over the handle of the controller, and the car travels slowly at first, then passes through five intervening speeds (at any of which the lift can be run if so desired), and eventually reaches its sixth or maximum speed of 450 ft. per minute. This speed, it is said, can be reached within 8 ft. of travel, and when it arrives within a similar distance from the end of its journey the lift begins automatically to reduce its speed by an ingenious method, finally stopping after attaining its slowest speed. The equipment in the basement is driven by a 25-h.p. motor, which has been found necessary to attain the speed mentioned under load. The special brakes which come into operation in stopping the lift are automatically adjusted according to the load. The provision in the way of safety appliances is claimed to be such that, in the event of one of the four ropes merely stretching, the cage would immediately come to a standstill. The 500-volt supply of the County of London Electric Lighting Co. is employed. Messrs. Penrose have recently carried out a large number of electric lift contracts for London and the provinces, and four lifts for Johannesburg; one of these contracts was for the *Tribune* offices in Bouverie Street, where there are installed passenger and forme lifts, patent paper elevator and 2½-ton crane.

Trade Announcements.—Mr. W. Stanley Williams, late of the Wrexham Corporation Electricity Works, has commenced business as an electrical engineer and contractor at 44, Chester Street, Wrexham.

Mr. J. F. Coates, who was for eight years on the Burnley Corporation electricity staff, has opened an electrical engineer's business at 18, Hebrew Road, Burnley.

Outing.—Last week the tramway employés of the Nelson Corporation had an outing to Gargrave *vid* Gisburn and Hellifield. The party were accompanied by the borough electrical engineer, Mr. Henry.

France.—La Societé Lyonnaise des Forces Motrices du Rhone, of Lyons, reports a profit of £62,294 for the last financial year, which admits of a dividend of 19 fr. per share, as compared with only 16 f. for the preceding 12 months.

Lead Wool.—We have received from the LEAD WOOL COMPANY, of Snodland, Kent, samples of its new material known as "lead wool," which is suitable for jointing gas, water and other mains such as pipes for telegraph and telephone wires. The material has been patented by the company, which also holds the patents for joints made with metal wires, threads, &c. In a pamphlet which the company has issued, the disadvantages and defects of the ordinary methods of jointing pipes, with hemp yarn and molten lead, are emphasised, and the special merits of the new system are explained. After the introduction of the yarn, a strand of the lead wool is twisted up to fit the space in the socket, and is well caulked in, each turn being individually caulked, until the socket is filled. The lead wool, it is claimed, then forms a dense mass of lead, capable of withstanding a much greater pressure than the ordinary packing, as evidenced by tests. The joints can be made in damp weather or in water, where molten lead could not be used, and the use of fire, clay, &c., is avoided. There is no waste of either time or material; moreover, the company claims that half the weight of lead suffices. The new material was first used in Germany; the Lead Wool Co. is the sole licensee and manufacturer in this country.

Training in Wireless Telegraphy.—Mr. WILLIAM LYND, the principal of the British School of Telegraphy, 179, Clapham Road, London, S.E., has received from H.M. Postmaster-General a licence to use, for the training of Marconi wireless telegraph operators, the installation supplied by Marconi's Wireless Telegraph Co., Ltd. Mr. Marconi's magnetic detectors are included in the installation.

Italy.—La Societa Italiana per Accumulatori Elettrica is the name of a new company which has just been formed in Milan, with a capital of £20,000, to manufacture accumulators.

LIGHTING and POWER NOTES.

Barton (Lancs.).—With reference to the E.L. order granted to the R.D.C. for the parishes of Flixton, Clifton, Davyhulme and Barton Moss, the Flixton P.C., which has all through opposed the scheme, has decided to inform the B. of T. that the Council considers the granting of the order to be a great injustice to Flixton, and asking if there is any higher authority to whom the Council can appeal against the Board's decision. Flixton is applying for urban powers, and, if successful, desires to possess its own E.L. order.

Brighton.—The Right Hon. John Burns, M.P., President of the L.G.B., is to open the Corporation's new Southwick generating station on June 16th.

Bromsgrove.—The B. of T. has informed the R.D.C. that the Bromsgrove E.L. order (1901) has been revoked.

Bury (Lancs.).—The Electricity Committee of the T.C. has decided to reduce the charges for energy as under:—Shop lighting, from 4d. to 3½d. per unit; hotels, &c., from 3½d. to 3d. Motive-power, 2d. per unit to users of the maximum demand of one hour per day, or for 1,000 units per quarter; 1d. per unit for the next 1,500 units, and ¾d. per unit beyond, less 10 per cent. Public lighting, a reduction of £1 per lamp per annum.

Canada.—ONTARIO.—As foreshadowed in a note from our Canadian correspondent last week, the Electric Power Bill has been read a third time, and has received the Royal assent. The Lieut.-Governor in proroguing the Provincial Parliament, expressed satisfaction that the reports of the Hydro-Electric Commission had resulted in a measure which was designed to secure cheap power to all parts of the province without injury to the rights of bondholders and others who had invested money in the development of electrical energy.

Cheddleton.—The Staffordshire C.C. has decided to expend £1,600 on the installation of the E.L., £900 on telephones, and £400 on electric fire alarms at the new asylum building at Cheddleton.

Chester.—The T.C. on May 23rd decided to reduce the price of energy as under as from September 30th next:—Private lighting, from 4d. to 3½d. per unit; power, from 2d. for the first 500 units per quarter to 1½d. per unit; above 500 units per quarter, from 1½d. to 1¼d. per unit for the first 200 units, and 1d. beyond.

Colne.—An unopposed L.G.B. inquiry into the application of the T.C. for a loan of £5,300 for E.L. purposes, was held on May 23rd.

Continental Notes.—ITALY (BRESCIA).—The Prefect has granted a concession to the cotton works of Messrs. Turati to take sufficient water from the left bank of the Dezzo Torrent near Mazzunno, to generate 7,962 H.P. for the supply energy of the cotton works and for distribution in the neighbourhood.

Another concession has been granted to take water from the Paspardo (Cimbergo) for generating 1,634 H.P. to be utilised for industrial purposes, amongst others, in the preparation of barium salts.

CHIETI.—A concession has been granted to obtain energy from the River Sangro sufficient to develop 5,133 H.P., part of which will be used in connection with a tramway on the provincial routes between Frentana and Sangritana.

Dublin.—The Lighting Committee has recommended that from the commencement of the present quarter the price of energy for power purposes shall be reduced to 3d. and 1d., one hour maximum demand, or 1¾d. per unit flat rate. The Committee has also adopted a basis by which it hopes to attract small power users, *i.e.*, the cost shall not exceed 7d. per day per H.P. installed. Consumers of over 3,000 and under 5,000 units will be charged 1½d. per unit, flat rate; over 5,000, 1¼d. per unit; and daily newspaper offices 1¼d. per unit. Further, new lighting flat rates are recommended for public establishments, and also reductions in meter rents. So as to allow some abatement to new consumers to relieve the initial cost of wiring premises, the Committee puts forward for approval by the Corporation, a suggestion that they should be supplied with energy for the first six months at one-half the ordinary rates.

Edinburgh.—Some time ago the E.L. Committee instructed its consulting engineer, Sir A. W. B. Kennedy, and the resident engineer to report on the present condition of the plant, its probable life, and on the question of provision for renewals. The engineers recommend that the Council should increase the reserve fund to its statutory limit, and also create a depreciation fund as soon as possible. Five per cent. on the capital outlay is allowed for the latter, and the reserve fund now amounts to £76,000, or short on a capital expenditure of £900,000 by £14,000. The actual sum taken from the surplus of the electricity account, and placed to the credit of the city in some form or another, has been £25,539.

The Lighting Committee of the T.C. has, after consideration, come to the conclusion that no appreciable advantage would accrue from scrapping the existing small plant in use at Edinburgh in favour of larger or more modern machinery.

Exeter.—The working of the Corporation's electricity undertaking for the year just ended has resulted in a net profit of £995. The total revenue was £14,624, and the working expenses £7,240; interest and sinking fund charges absorbed £6,389. The units sold amounted to 587,211 for lighting and power, and 365,098 for traction.

Falkirk.—At a recent T.C. meeting, a proposal to confer with the Scottish Central Electric Power Co. before accepting contracts for the extension of the electric plant of the burgh, was after lengthy discussion, defeated by 11 votes to 3.

Fife.—We understand that three-phase coal-cutting machinery is now being employed in the Bowhill Colliery. Two large size Pick-Quick coal-cutters, each capable of under-cutting 6 ft., and a smaller one with a 4 ft. 8 in. under-cut, are being employed; a large machine has cut 60 sq. yds., or 30 lineal yds., per hour, including stoppages.

Glasgow.—A proposal to reduce the charges made for hydraulic water power met with keen opposition at the meeting of the T.C. It was contended that if the proposal was carried, the electricity department would be compelled to reduce their charges for power supplied for similar purposes, which might end in a rate-cutting war between the two departments. It was pointed out that the hydraulic power supply did not pay, but the proposal was ultimately agreed to.

Grantham.—The E.L. Co. has reduced the price of energy to 5d. per unit.

Grimsby.—The Corporation E.L. undertaking realised a profit of £1,004 in the twelve months ended March, 1906. Of this amount £500 is to be applied to the rates, £300 to depreciation, and £200 to a sinking fund. The charge to private consumers is to be reduced from 4½d. to 4d. per unit.

Heckmondwike.—The U.D.C. has applied to the L.G.B. for a loan of £19,500 for electricity purposes.

India.—CALCUTTA.—The Calcutta Electric Supply Corporation was founded long before the passing of the Indian Electricity Act of 1905, which introduced standard conditions throughout the Indian Empire in place of a system of private Bill legislation. Wishing to extend its plant and operations, the Supply Co. has been in negotiation with the Government for the surrender of its old licenses for one under the new Act. Into these negotiations the Calcutta Corporation has intervened, and shown the municipalistic spirit by asking for sweeping reductions in charges, and for the right to levy a rent of at least 100 rupees per annum on each mile of underground cable, and an annual rental of 5 rupees for each pole and 10 rupees for each tripod carrying overhead mains. It also suggests that in cable laying the length of trench open at one time in any street should not exceed 60 yards, while at junctions only one-half should be open and the remainder left clear. The Government has thrown its influence on the side of the licensees, and met the municipal criticism by the remark that such reductions in price as are demanded would involve the virtual confiscation of the property of the supply company.

Leyton.—It was decided by the U.D.C. on Tuesday to convert the whole of the remaining gas lamps in the district to electric, at a capital expenditure of £2,216, and an increased annual expenditure of £628. The surveyor, in conjunction with the

electrical engineer, was instructed to report as to the lamps which are to be converted during the current half-year. Sanction has been received from the L.G.B. to the borrowing of £17,819 for extensions to the power station.

Leek.—A local silk mill was recently closed owing to an accident to the 90-H.P. engine which drove the mill. The services of the borough electrical engineer, Mr. R. M. Carr, were requisitioned on Tuesday afternoon; an estimate having been made as to the horse-power required for each room, all the necessary arrangements were put in hand to install motors, and by Thursday several of the rooms were running; by the end of the week 10 motors, having an aggregate of 70 H.P., were installed. The plant is giving entire satisfaction, and the advantages of the steady electrical drive have already been noted in the quality of the work turned out.

London.—L.C.C.—The Finance Committee, in reporting at Tuesday's meeting of the Council, on an application of Bermondsey B.C. for the advance of £15,507 for machinery, mains and meters, stated that with the exception of £700 required for meters, the whole of the sum to be borrowed had already been expended. In reply to a communication on the subject, the B.C. intimated that it was under the impression that it was not absolutely necessary to apply for such sanction before the extensions were undertaken; that the electricity department had recently been reorganised; and that it was now understood that in future the Council's authority should be obtained before any such expenditure was incurred. On this explanation the C.C. decided to advance the money. It was also resolved to lend £22,303 to the Islington B.C. for electric lighting works, and £2,650 to the Poplar Council for installing a coal elevator plant at the generating station.

CAMBERWELL.—The London Electric Supply Corporation has notified the B.C. of its intention to lay new 6,600-volt mains in New Cross Road and Queen's Road, Peckham. The Committee has considered a communication from the town clerk to the effect that it is probable that these mains will be used for the supply of electricity for the L.C.C. tramways, and that it is necessary to provide that such mains shall not be charged against the Camberwell undertaking of the company in the event of the Council at any time deciding to exercise its powers of purchase. The company has stated that the mains are intended to be used for any purpose which may arise for both power and lighting; at present there is no demand for a tramway supply from these mains. The Committee has given the permission asked, subject to protective conditions, including one that the work shall be carried out continuously, night and day if required, by the Council.

HAMMERSMITH.—Upon the advice of the electrical engineer, 12 "Chameleon" electric signs containing particulars of rates of current, &c., are to be obtained at a cost of £3 3s. each, and are to be distributed amongst electrical fitters and ironmongers in the borough, to be placed in prominent positions in their shops and showrooms.

POPLAR.—The agreement which has been come to by the B.C. with the London and India Dock Co. for the supply of energy, comprises the following clauses:—The company is to pay a rent of £30 per annum for the service; the agreement is to be for five years terminable at the option of the company at the end of three years, subject to the company paying £50 towards the cost of removal of the cable on its premises; the charge for a minimum consumption of 300,000 units per annum is to be ·885d. per unit, and ·9d. per unit for a minimum of 200,000 units per annum; in the event of the consumption per annum not reaching 300,000 units the company is to have the option of charge at the standard tariff rate of £3 per KW. plus ·8d. per unit. The charge for each annual period is to be adjusted on these rates, the normal maximum load is not to exceed 80 KW., and the out-of-balance current not to exceed 20 amperes at any one time.

WEST END.—Owing to the fusing of an electric light main on Monday, in a street box in Argyle Place, the daily Press reports that a gas main exploded, and some damage was done to the pavement and to a jeweller's shop.

METROPOLITAN ASYLUMS BOARD.—Owing to the very inferior lighting obtaining at the Downs School by gas, it has been unanimously decided to install the E.L. at a cost of £2,700. The Board's engineer has reported that in consequence of the increased demands on the X-ray apparatus used for the treatment of the children, an outlay of £100 would be required in the near future in order to provide additional electrical energy, but that this could be provided by the installation, the cost of which includes wiring, fittings, mains, switchboards and a small motor-generator for the X-ray apparatus. The South Metropolitan E.L. and Tramways Co. has offered to supply energy at the same rate as to Belmont Asylum, viz., 2¼d. per unit, and on this price a saving over gas of £25 per annum will be effected, and there will be a 25 per cent. better light, pure air, greater cleanliness and less expenditure on cleaning and painting work, with a saving of expenditure on the renewal of accumulators for the X-ray apparatus, and on running the laundry machinery on Saturdays and after hours.

New Zealand.—WAIHI.—In reference to the note in our issue of March 16th last, stating that the Waihi Gold Mining Co. had asked the Government for permission to utilise the energy of the Horahora Rapids for generating electricity, it is now announced that the latter has definitely refused the company's application. The reason given is that the Government proposes to develop the Huka Falls, and it desires the company to purchase a supply from that source. So far as can be seen, however, it will not be possible for the company to operate on low-grade ores with a supply from the Government's scheme, as the cost will be heavier. An outline of the Waihi company's scheme, by its consulting engineer, recently appeared in a New Zealand paper, which stated that the capital cost would be £70,000, and the power developed at the Falls would be 3,800 H.P.; the transmission line would be 52 miles long. A loss in transmission and transforming of 25 per cent. is estimated, and if the mills are run 24 hours per day for six days per week, the cost would work out at £3 per H.P. per annum, exclusive of licence fee, &c. The Government scheme would entail a 100-mile transmission line, and the cost of supply is put at about double that by the company's project.

A public meeting has been held in the town, and a resolution passed, asking the Government to reconsider its decision. The Government's action is being condemned by all classes in the Colony.

DUNEDIN.—The new railway station and yards are to be lit by electricity and a 70-H.P. gas or oil engine set is to be installed on the station ground for the purpose.

TIMARU.—The B.C. has accepted an offer by Messrs. Scott Bros., of Christchurch, to install a plant for lighting the streets by electricity and to supply energy to private consumers. The company agrees to erect and maintain five 1,000-C.P. lamps, 20 500-C.P. lamps, and 210 30-C.P. lamps for £750 per annum, on an average of 4½ hours lighting per night. Private consumers are to be supplied through the Council at 1s. per unit for lighting, and 4d. for power. The Council has the right to purchase the undertaking at any time upon conditions agreed, and after a certain period the mains, connections, &c., become its property free of cost. The initial schemes provide for a plant of 70 KW., overhead distribution is to be used.

AUCKLAND.—The C.C. has adopted Mr. Goodman's scheme for electricity supply in conjunction with the refuse destructor, and has decided to take a poll of the ratepayers for sanction to the borrowing of £25,000 for the purpose. The cost of the scheme is estimated as follows:—Buildings, £3,000; plant, including battery, foundations, &c., £10,576; overhead feeders and distributing mains, £6,624; total, £20,200. If a condenser, cooling tower, pump, &c., is installed, the cost will be £22,202. The three-wire direct-current distribution system with 440 volts on the outers, has been adopted, and the plant to be installed in the first place is to be two 225-KW. units, one boiler and one storage battery. Street lighting is not recommended at the start. Consumers are to be charged 1s. per unit, with a sliding scale of discounts.

CHRISTCHURCH.—All material in connection with the electric lighting and power supply for the International Exhibition, will be supplied by the Australian General Electric Co. The work is being carried out by Messrs. Scott Bros., of Christchurch.

WELLINGTON.—As previously mentioned, the C.C. has been considering the question of taking over the City of Wellington Electric Light and Power Co.'s undertaking. An offer by the C.C. of £100,000 was made to the company for its interests, but this has been declined by the company. The Council intimated that if the company did not accept its offer, it would probably submit to the ratepayers a proposal for a loan to erect independent works. The company contends that it has the monopoly of the private supply of Wellington; the C.C. disputes this and is now supplying energy for lighting and power to some business houses in the city from its traction plant. The company estimates the value of its undertaking at £175,000.

At a special meeting of the C.C. it was resolved to ask the ratepayers to sanction the following loans:—New tramway cars, £25,000; power supply scheme, £30,000; purchase of 1,000-H.P. steam dynamo, with condensers, two boilers, superheaters, pipes, pump, and switchboard panel, £12,600; two 100-KW. motor-alternators with switchboard, boosters, £4,145 (less proportion chargeable to public lighting loan, £6,518); allowance for future extensions, £10,000—total, £21,000; additions to public lighting for, say, two years, £10,000; for starting new electric lighting works, £100,000; Charlotte Street tramway deviation, £2,000.

Pontypool.—A gas explosion in the street recently drew attention to leakage from the electric lighting mains. The cables are lead-covered and were laid 13 years ago.

Redruth.—The Urban Electric Supply Co. has reduced the price of energy from 6d. to 5d. per unit.

Shrewsbury.—There is a credit balance on the year's working of the T.C.'s undertaking of £824.

South Africa.—DURBAN.—The borough electrical engineer reports that at the end of April there were 144,366 lamps connected or applied for, the total number of consumers being 3,524. The new Belliss-E.C.C. 750-KW. alternator has been put into operation with satisfactory results.

The Committee has recommended the proposal of the borough electrical engineer to make a special charge of 4d. for shop window lighting, which will necessitate the use of time switches. In order to encourage the use of energy for cooking and other purposes during the time of light load, it was suggested that it be supplied at 1½d. per unit from 12 midnight to 6 p.m., and from 6 p.m. until midnight at the existing tariff, 8d. per unit, less discounts. The suggestions were favourably received, and remitted to the whole Committee of the Council.

PORT ELIZABETH.—The electricity works of the Port Elizabeth Corporation were opened on May 1st, by the Mayor. The borough electrical engineer is Mr. R. Pape, who has also designed

the system. The cost of the works, including mains and street lighting, was estimated at £83,480, but has amounted to only £76,000; adding to this £3,300 for the cost of site and £5,087 the cost of procuring the necessary capital, the total cost of the whole of the undertaking is about £85,000. The street lighting is estimated to cost £12,000, and will consist of 110 arc and 450 Nernst lamps. The pressure of supply is 250 and 500 volts, and the cables are triple-concentric laid solid. Already over 1,000 private lamps are connected, and there are several thousand more in course of connection.

Southport.—The twelfth year's working of the Southport Corporation electricity undertaking has been submitted to the Electricity Committee. During the year 149 additional consumers were connected to the mains, with the equivalent of 7,526 8-c.p. lamps. As compared with the previous year there has been a substantial increase in the number of units sold to the Tramways Committee and the Southport Tramways Co., Ltd., the increased sales being 7·7 per cent and 18·6 per cent. respectively. The units sold to private consumers increased from 1,023,892 to 1,101,801. The price to new domestic consumers has been fixed at a flat rate of 4½d. per unit, and the old consumers have been given the option of this flat rate or remaining on the maximum demand system. A battery connected with the traction system, together with an automatic reversible booster and switchboard, has been installed. By means of the battery the whole of the direct current supply, except on Bank Holidays, will be given by one 200-kw. generating set, and the running hours of the steam plant have been reduced 60 per cent., improving the plant load factor from 30 per cent. to 72 per cent. The result of the year's working was a net profit of £3,375. From a total revenue of £23,659 there was a gross profit of £14,710, equivalent to 7·96 per cent. on the average capital, against a percentage of 8·19 last year. Interest and sinking fund absorbed £11,334. The surplus was dealt with as follows: In aid of the rates, £2,750; renewals fund, £625 15s. 6d.

Stourport.—The B. of T. has granted a prov. order for E.L. to the Kidderminster and District E.L. and Traction Co., Ltd., for Stourport and the R.D.C. of Kidderminster.

Wellingborough.—The U.D.C. has decided to take no action whatever with regard to the application of the Northants Electric Power and Lighting Co. for a prov. order for E.L. Rushden U.D.C. has decided to oppose the application.

TRAMWAY and RAILWAY NOTES.

Bolton.—On Wednesday last week an overhead wire broke and became entangled with the trolley pole of a tramcar. The trolley rope swung about and struck a passenger on the head. His injuries were not of a serious nature.

Bradford-Cleckheaton.—Cleckheaton U.D.C. has been informed that the Tramways Committee of the Bradford T.C. has decided that it cannot see its way at the present time to extend the electric tramways to Oakenshaw, Cleckheaton.

Brentford.—The B. of T. inspection of the new tramway line connecting Brentford and Hanwell took place on Wednesday last week, and the line will be in operation very shortly.

Burnley.—The annual return of the Corporation electrical tramways shows that up to date the capital expenditure has been £186,856, there being an increase for the year of £1,068, of which £1,026 was for lines. The total revenue for the year to March 31st, 1906, was £57,992, of which £57,451 was derived from passengers, the balance being from parcels. The income averaged 11·511d. per car-mile, against 10·467d. in 1904-5. The passengers carried numbered 11,092,704, against 10,037,379, and the car-miles run 1,107,772, against 1,226,661. The total receipts per mile were 11·61d., against 10·56d., and total expenditure 8·17d., against 7·92d. Forty-six cars were in use, running an average of 120 miles a day. The total route length is 10¾ miles, and there is yet £24,464 in unexpended capital authorised to be spent.

Callington.—The Great Western Railway Co. has applied to the Light Railway Commissioners for an order authorising the abandonment of the system authorised by the order of 1900, and in its place the construction of a line between Callington and Saltash, commencing at St. Stephens-by-Saltash, and thence to Callington *vid* Landrake, Botusfleming, Pillaton and St. Mellion.

Canada.—The Toronto Railway Co. and the Toronto and York Radial Railway Co., which are now virtually one concern, have issued a document describing and giving the values of all buildings, plant and rolling stock of the two companies. The total value of property held by the two companies amounts to $3,066,000. Of this amount, $502,000 is for buildings and permanent fixtures, $1,062,000 for plant such as boilers, engines, dynamos, generators, transformers, &c., and $1,502,000 for rolling stock.

Continental Notes.—Italy.—Our contemporary, the *Elettricita*, of Milan, on April 27th last published a portrait of Dr. Geo. Finzi, and a detailed account, with numerous illustrations and sketches, of the railway which has been laid and is working at the Exhibition between the Park and the Piazza d'Armi. The line is carried on a viaduct constructed partly of iron and partly of wood at a height of about 6 metres from the ground to the rail level, with a sloping approach to the station for the ascent and descent of the passengers. In the generating station the alternators work at 2,000 volts and 15 periods; they are constructed with 4 poles, driven direct by three-phase motors of 600 h.p. working at 3,600 volts and 42 periods. The rolling stock consists of four trains with half a train in reserve, each train being composed of four carriages, 10 metres in length, capable of seating 96 persons, with a total carrying capacity up to 250 persons. To the trolley pole is fitted a novel collector consisting of two parallel rollers attached to a spring frame work, designed to avoid sparking; transformers of 40 kw. capacity are carried on the train, reducing the pressure to 180 volts.

According to the Continental Press, an electric railway is to be constructed to unite Varese with the Luino railway. The plans have already been passed, and the work is shortly to be proceeded with.

The electrical locomotives intended for traction in the Simplon tunnel are now completed; they have a total length of 12·32 metres and weigh 62 tons. They are fitted with two motors of 600 h.p. each; these, it is calculated, will pull a 300-ton passenger train at 84 km. an hour, and a 400-ton mineral train at 68 km. an hour. The power will be supplied at 3,000 volts, and it is intended that the locomotives shall pull the trains about 40 km. to the station at Domodossola.

The power required for working the electric locomotives is derived from two generating stations situated at Brieg and Iselle respectively, where additional plant has been installed for the purpose. The generators yield three-phase current at 3,300 volts, and two sets of feeder cables are led from each station for the supply of the trolley wires, which are arranged over the track in the tunnels, and are divided into five sections limited by both railway stations, both tunnel doors, and the turnout or siding in the tunnel. The trolley wires are fixed on insulators which are attached to steel wires, and at the tunnel portals they are separated from the trolley wires outside the tunnels, as space has to be provided for the "curtains" which close both tunnel portals. An electrically-operated windlass is provided for raising the curtain before the passage of a train; it is brought into action by pressing a push button, and becomes automatically disconnected when the curtain has reached its highest or lowest position. Each locomotive is fitted with two overhead collectors which lead the current from the trolley wires at 3,000 volts. Two air pumps are arranged on each locomotive, one being for the operation of the Westinghouse brake and the other for the acoustic signals; the current for the pumps and for lighting is provided by means of oil transformers, which reduce the 3,000-volt current to 110 volts.

An interesting test case has recently been before the Law Courts of Rome, in regard to the work permissible in carrying overhead conductors across private property, under the law of June, 1894. By this law it is distinctly indicated that no compulsory wayleaves shall be granted to fix overhead conductors "to the front of houses towards the street, across public squares, courts, gardens, or places planted with fruit trees." The Electric Tramway and Railway Co., of Rome, demanded a wayleave from Messrs. Torloni, part of it traversing land where fruit trees were planted. In considering the case, the Judge interpreted the law as referring to fruit gardens attached to houses or villas, and decided that such plots of land as that in question, although planted with fruit trees, were not afforded protection by the statute; permission was therefore granted to the company to carry their conductors along the projected route.

Finland.—The British Vice-Consul at Abo, in a recent report, states that there is a possibility of having a system of electric tramways put down in that town, and he hopes that British manufacturers of plant will enter into competition.

Spain.—The Sociedad Anonima Electrica Moderna, of Jerez, has applied to the Spanish Minister "de Fomento" for a concession for the construction and exploitation of an electric tramway in Jerez de la Frontera.

Sicily.—The British Vice-Consul at Catania, in a recent report, states that the electric tramway service in that town was opened to traffic on April 1st, 1905, and promises to be a success from a financial point of view. The motive power is produced by two Dowson gas engines of 500 h.p. each, which will be sufficient also for an electric light service which the company proposes to furnish to the public very shortly.

Holland.—The British Consul at Rotterdam reports that on September 1st, 1905, the first electric tramway commenced running. Only one line is at present in working order, but it is hoped that the major portion of the system will be completed this year, and with this view active operations are being carried on towards completing the generating station.

Croydon.—On Saturday last the new route between Tooting and Croydon was opened for public traffic. There is still a gap of ½ mile between the terminus at Tooting Junction and that of the L.C.C. tramways at Tooting Broadway.

Halifax.—At a meeting of the Corporation Tramways Committee on May 24th it was reported that the past year's operations had resulted in a profit of £3,177, £932 more than had been estimated.

(*Continued on page* 887.)

THE LANCASHIRE ELECTRIC POWER SCHEME.

(*Concluded from page* 846.)

For the oil circulation to the turbines, oil pumps are provided in the basement; they supply an oil cistern at the top of the building, from which the oil flows by gravity through the turbine bearings and back to the pumps.

The condensers (one for each turbine unit) are of the vertical surface type, with three-throw Edwards air pumps direct driven by motors, and were supplied by the Mirrlees, Watson Co.

A dry air pump is also installed in connection with the above plant, and is available for priming the circulating pumps.

The latter are of the centrifugal type, direct motor driven, and are installed in the basement: each is rated to lift 160,000 gallons per hour from the river, against a head of 28 ft.

These pumps have separate suctions, and a common discharge which is submerged at its river end, with a view to preserving the syphonic action of the system. A view of the condensing plant is shown in fig. 12.

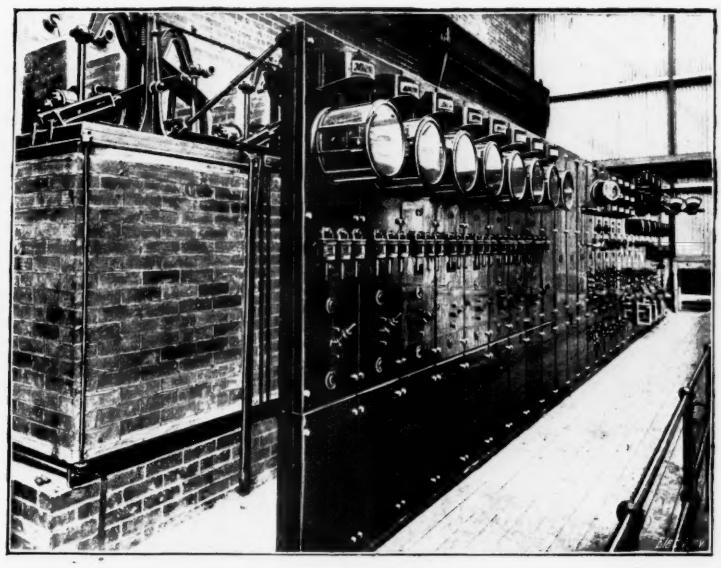


FIG. 11.—VIEW OF THE OPERATING SWITCHBOARD, RADCLIFFE POWER STATION.

The exciting plant, which also supplies the direct-current used throughout the station for various purposes, consists of three 150-KW. Allen-B.T.-H. non-condensing units, the generators being of the six-pole compound-wound type, of which a view is given in fig. 10, page 845.

A 25-ton three-motor electrically operated travelling

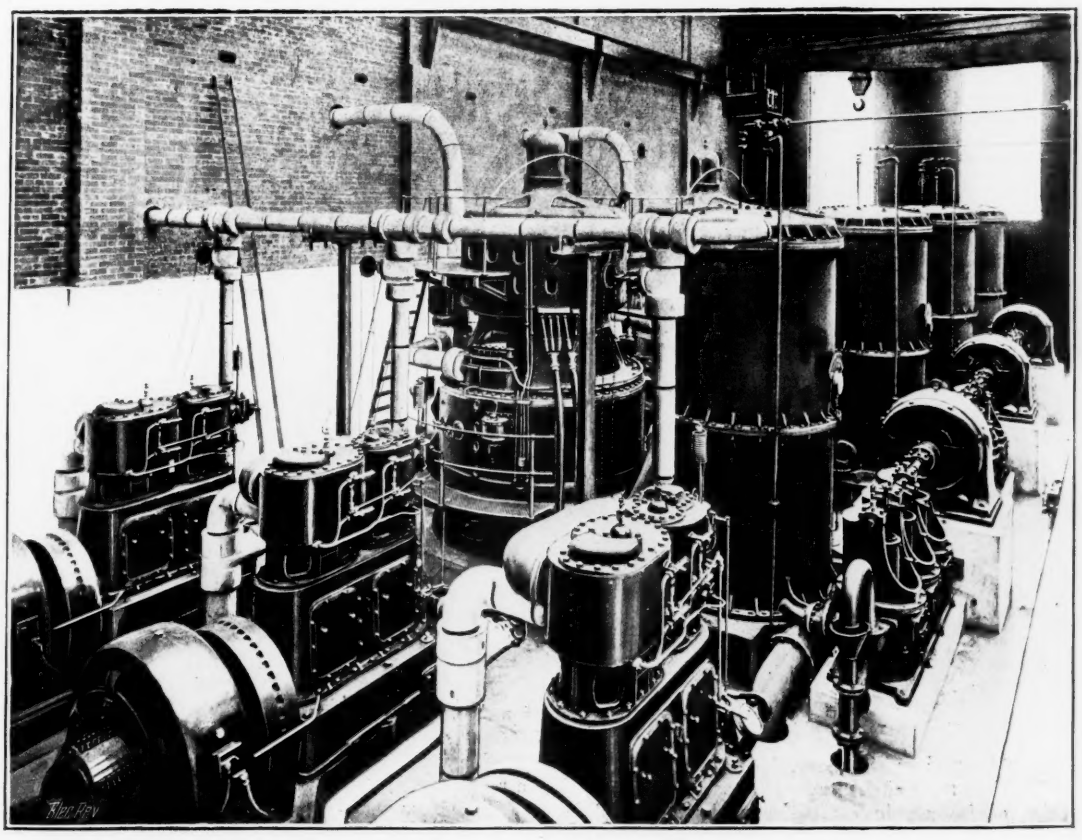


FIG. 12.—VIEW OF THE ENGINE ROOM FROM THE SWITCH GALLERY, SHOWING THE SURFACE CONDENSING PLANT, &c.

crane, which spans the engine room, facilitates erection and repairs.

The switchgear, in common with the plant just referred to, is practically identical with that installed at the Yorkshire Power Co.'s Thornhill power station: it occupies three floors at one side of the engine house, and is of the British Thomson-Houston Co.'s standard construction.

Each generator is connected through an oil switch and isolating switch to the main bus-bars; the latter are divided into halves, coupled by a sectional oil switch with isolating switches on either side; two generators being connected to each half section. Eight feeders are provided for, four lead from each half section of the bus-bars through oil switches provided with isolating links on either side; the feeders are in duplicate, one being coupled to each half of the bus-bars. The oil switches are motor operated, by direct current, and are controlled from the operating switchboard (fig. 11) situated on a gallery overlooking the engine room; the board contains the usual equipment of instruments, automatic cut-outs, synchronising gear, indicating lamps, &c., and the auxiliary D.C. switchgear for the exciting units.

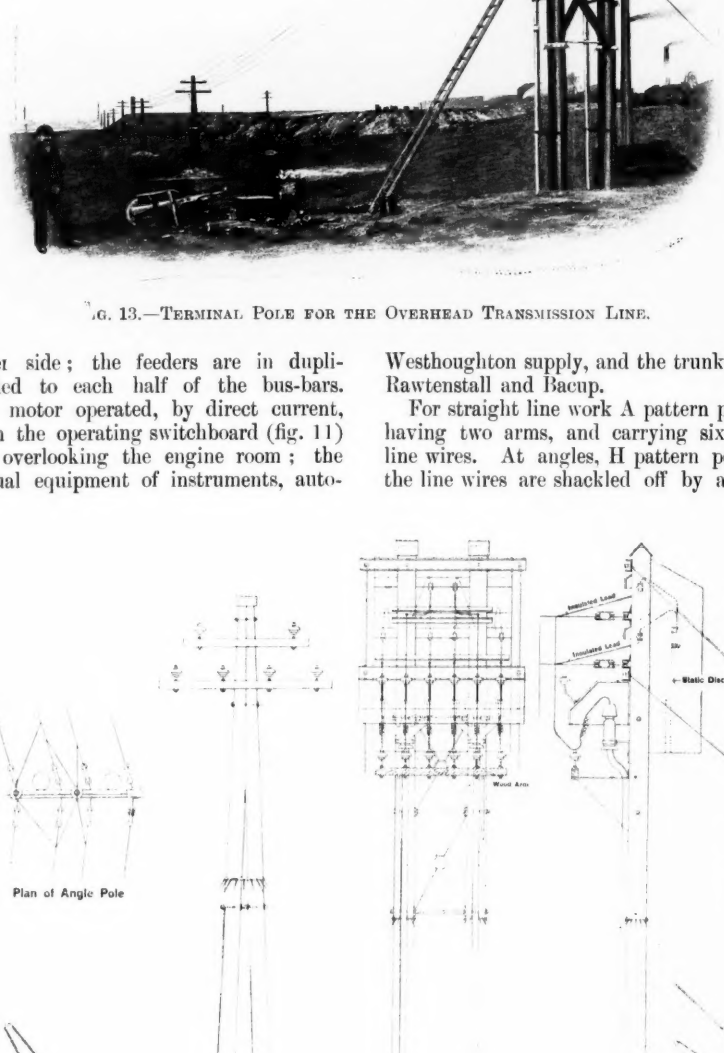


FIG. 13.—TERMINAL POLE FOR THE OVERHEAD TRANSMISSION LINE.

A point of interest in connection with the Radcliffe station is the employment of overhead transmission in connection with the outgoing feeders. The three insulated lead-sheathed cables from the terminals of each feeder oil switch are carried up the side of the building (as shown in fig. 4) and pass through ducts, built into the wall, to porcelain terminal insulators outside. These insulators are supported on a framework and protected by a roofing of fireproof construction, as shown in fig. 8, page 845.

The transmission lines are attached to the framework by a series of three shackle insulators for each line. Two duplicate circuits go direct across the river Irwell to transmission poles on the other side of the river: another duplicate circuit is carried on insulators on the face of the building to a pole situated near the corner of the power house, and thence runs in a southerly direction towards Swinton. The first two duplicate sets of lines are for the Westhoughton supply, and the trunk main running towards Rawtenstall and Bacup.

For straight line work A pattern poles are used, each pole having two arms, and carrying six insulators for the six line wires. At angles, H pattern poles are used, to which the line wires are shackled off by an arrangement of three shackle insulators in series for each line wire, and a similar arrangement is used for terminal poles.

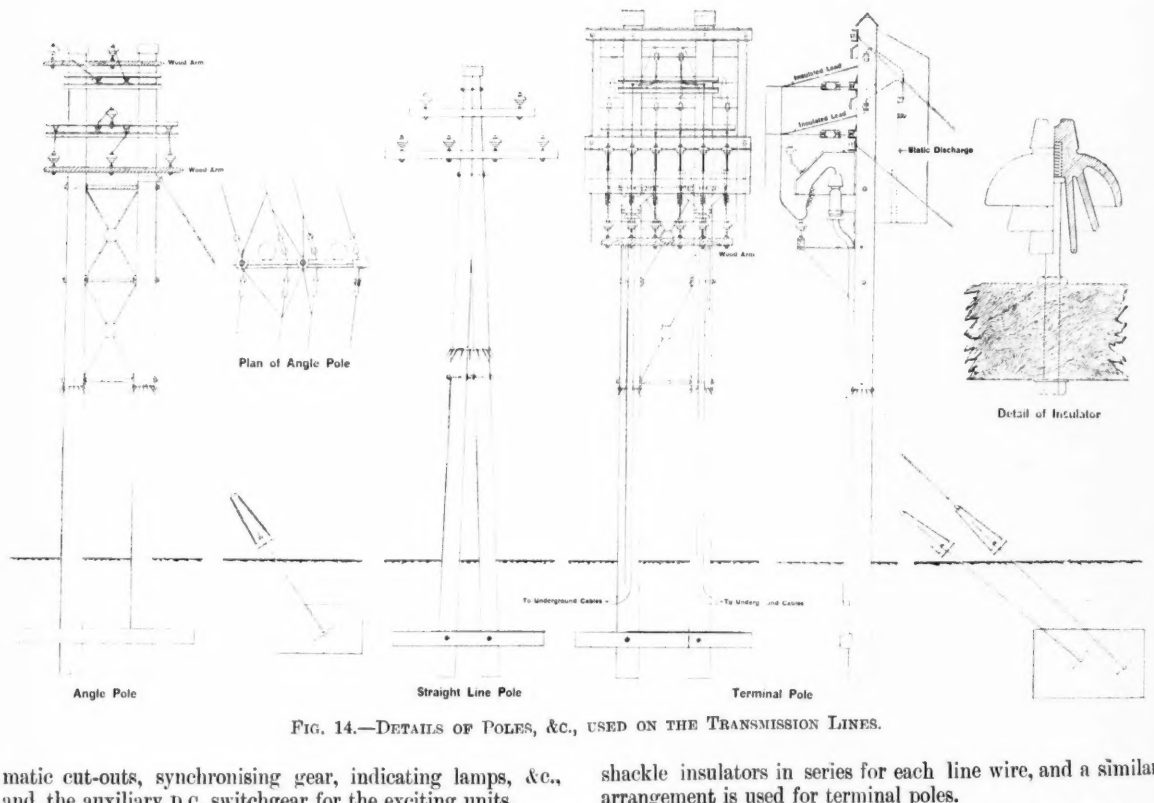


FIG. 14.—DETAILS OF POLES, &C., USED ON THE TRANSMISSION LINES.

The poles are of Norway fir, tapered from 11 in. to 8 in. diameter; the standard lengths are for A poles, 32 ft.; H poles are any suitable length, according to position

(generally about 34 ft.) The cross-arms are of oak, the upper one being 6 ft. 8 in. and the lower one 9 ft. 2 in. long; they are of 5 in. × 4 in. section, secured to the poles

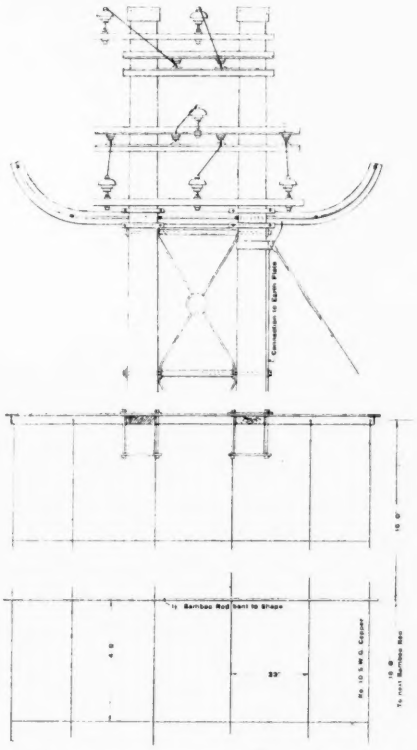


Fig. 15.—Cradle Adopted at Road Crossings, &c.

by two iron bolts. The upper arm carries two porcelain insulators of the triple shed pattern, made in two pieces cemented together and mounted on steel bolts: the insulators were supplied by Messrs. Bullers, Ltd. Details of the poles and insulators are shown in fig. 14.

Where the transmission line crosses a road, special cradles are provided, consisting of a network of No. 10 s.w.g. copper wires attached to steel angles fixed to the poles, these being curved as shown in fig. 15, and connected to an earth-plate.

At the terminal poles where the overhead transmission lines terminate and are connected to the underground trunk feeders, special cast-iron trifurcating junction boxes are provided, in which the bare copper line wires are connected to the paper-insulated 3-core cables.

Lightning arresters of the B.T.-H. multi-gap pattern with carbon resistances in series with the spark-gaps, are also provided on the terminal poles.

The line wires are of 000 hard-drawn copper wire, of ·372 in. dia. On the line originally erected, the transmission wires were bound to the insulators by No. 12 s.w.g. binding wires, but on the new work a special mechanical clip shown in fig. 16 has been substituted for these binders.

The three transmission wires forming each circuit are equi-distant from one another, 30 in.: each pole carries the two separate circuits forming a duplicate feeder. The poles average 50 yds. apart, and are set 6 ft. deep in the ground.

Telephone wires are carried on an independent line of poles, as shown in fig. 13, the number of wires varying from 8 to 16. The standard length of telephone pole is 24 ft.; each pole carries three cross-arms.

The telephone circuits consist of No. 15 s.w.g. hard-

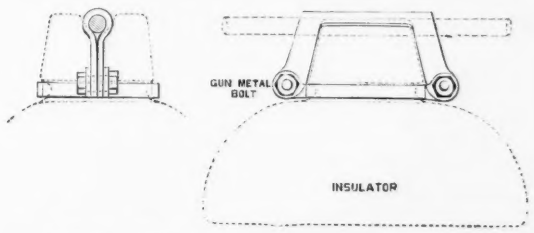


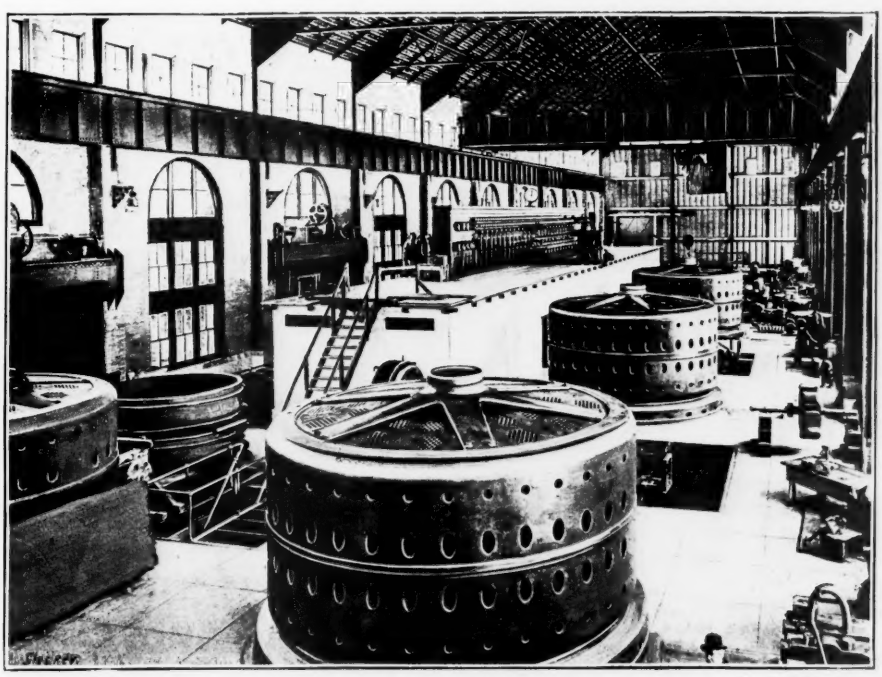
Fig. 16.—Detail of New Insulator Fastening.

drawn copper wire, carried on standard Post Office pattern insulators.

The total length of overhead transmission line erected is, approximately, 4½ miles of duplicate circuit (6 wires), and the length of underground transmission cable laid up to the present is, approximately, 21½ miles of duplicate mains.

The latter are 3-core paper-insulated lead-sheathed and steel wire armoured cables, laid solid in wooden troughs filled in with bitumen, one cable being laid in each trough: the covers for the troughing are of 1¼-in. board. Messrs. Callender's Cable & Construction Co., Ltd., were the contractors for the whole of the transmission network.

The sub-stations vary, of course, according to the class of work for which they are designed, but they are generally similar in arrangement to those of the Yorkshire scheme. One important point of difference, however, is that the



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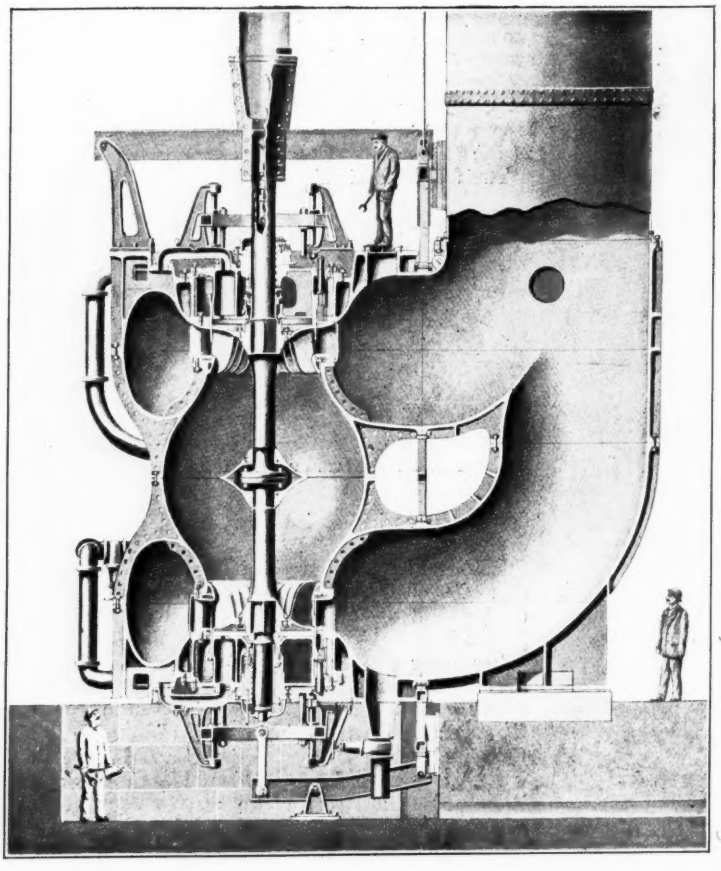
View of the 10,000-h.p. Turbo-Generators of the Canadian Niagara Power Co.

Lancashire Co. take duplicate 10,000-volt services direct to the consumer, without any preliminary stepping down of pressure, the consumer being provided with a suitable sub-station, in which he is unable to obtain access to the extra-

high-tension gear. The arrangement adopted allows the consumer to switch over from one duplicate feeder to the other, should a feeder oil switch break circuit, and he is thus able to determine whether the fault lies in his own or the company's apparatus.



SECTION THROUGH 13,000-H.P. TURBINE OF THE ELECTRICAL DEVELOPMENT CO., OF ONTARIO.

The first cotton mill in Lancashire specially designed for electrical driving was the Acme Spinning Mill, at Pendlebury, where a sub-station was installed for transforming the E.H.T. current to 420 volts, three-phase, for the motor circuits.

The motors are largely of the squirrel cage type, and total some 1,300 H.P., the mill being designed for 75,000 spindles.

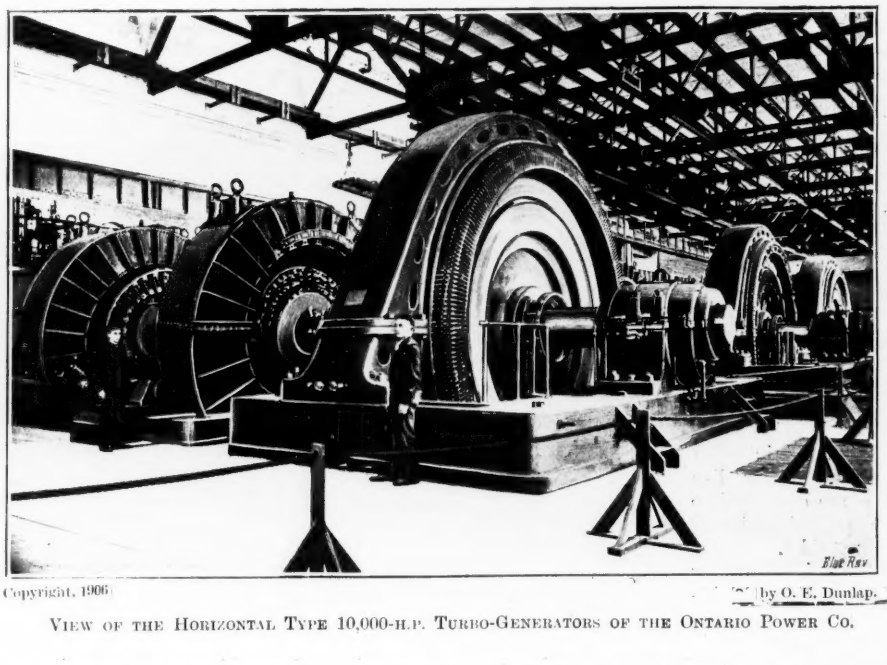
Fig. 9, page 845, shows the arrangement of a sub-station equipped with step-down transformers and motor-generators for supplying a direct current network, as in the case of the Swinton U.D.C.: sub-stations containing a static equipment only, will be put down at Westhoughton and Tottington for the supply of alternating current.

In the immediate vicinity of the company's generating station, excellent sites exist for factories, which would there secure the benefits not only of cheap power, but also of both railway and canal communication, essential features which led to the phenomenal industrial development of the Niagara region.

In conclusion, we beg to thank the joint consulting engineers, and others, for the facilities afforded in the preparation of this article.

ENGINEERING DEVELOPMENTS AT NIAGARA.

ACCORDING to our Niagara correspondent, Mr. Orrin E. Dunlap, opportunity is now afforded at Niagara Falls for the inspection of hydro-electric units of 10,000 H.P. and upwards, operated on both vertical and horizontal shafts. These installations are in the Power stations of the Canadian Niagara Power Co., the Ontario Power Co., and the huge plant of the Electrical Development Co., all on the Canadian side of the river. Those familiar with the various stages of the Niagara power development will recall the feeling that existed when it was announced that the International Niagara Commission, while in session in London, England, had adopted a 5,000-H.P. unit for the development then contemplated by the Niagara Falls Power Co. on the New York State side at the Falls. It was with wonder that many read that a deep wheel-pit would be sunk in the earth, and that from the bottom of this pit a big tunnel would be driven right under the city to the lower river and gorge, the tunnel to serve as the tail-race to carry off the water discharged from the wheels placed in the bottom of the wheel-pit. It was clear to engineers that an efficient head of water would be obtained by this method, but the adoption of a 5,000-H.P. unit was a marked advance, for up to that



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VIEW OF THE HORIZONTAL TYPE 10,000-H.P. TURBO-GENERATORS OF THE ONTARIO POWER CO.

time no such unit had been adopted for a hydro-electric development in America or Europe.

By April, 1895, just 11 years ago, the Niagara Falls Power Co.'s installation was so far advanced that the first unit was tested successfully, and it was recognised that the method of development was destined to win favour. Since then the installations of two great stations have been completed by the Niagara Falls Power Co., the machines having a total output capacity of 105,000 H.P. In both of these power stations the turbines and generators are connected by vertical shafts that extend up the wheel-pit. This installation has been so satisfactory that the Canadian Niagara Power Co., allied to the Niagara Falls Power Co., adopted the same method for the development of power on the Canadian side. However, the Canadian Niagara Power Co. made a bold step in advance, and selected a unit of 10,000 H.P. for its scheme. These 10,000 H.P. units were the first of the kind to be installed at Niagara, and four are now installed in the power house, a view of which is given on page 885. The overall diameter of these 10,000 H.P. units is only about 19 ft., and as each machine occupies only slightly more space than a machine that has an output capacity of 5,000 H.P., it is evident that a smaller wheel-pit and power house will give an equal amount of power as compared with installations where the unit is 5,000 H.P., and this results in a consequent reduction in the cost of construction. Thus the advantages are lower cost of generator and turbine per horse-power and reduced construction, as well as simplicity of operation and reduced cost of maintenance. These generators are wound for three-phase current, 11,000 volts, 25 cycles at 250 r.p.m. The station can be operated in parallel with either or both of the power stations of the Niagara Falls Power Co., cable connections having been made for this purpose by way of the upper steel arch bridge. A transmission line is to be built to Fort Erie and Buffalo along the Canadian side of the Niagara River, a complete right of way having been obtained.

It is in the power station of the Ontario Power Co. that the 10,000 H.P. turbine and generator sets have been installed on horizontal shafts, as shown on page 886, and these machines form a strange comparison with the plant just described. Previous to the erection of the station of the Ontario Power Co. on the Canadian side of the river, the Niagara Falls Hydraulic Power and Manufacturing Co. on the New York side, had been using the horizontal shaft system of development, but in the station of the latter company, each wheel operates two generators, while in the station of the Ontario Power Co. the generators are operated by twin wheels direct connected on horizontal shafts. The turbines were made in Germany, and the generators were supplied by the Westinghouse Co. The wheels in this station receive their water supply from the 18-ft. steel flume laid for over a mile through Victoria Park; and as the power house is at the water's edge in the gorge, the tail water soon reaches the river.

The installations in both of the power stations referred to are very notable, and each will interest engineers who in future visit Niagara. The stations are not very far apart, and are easily reached from either side of the river. It is from the generators in the Ontario Power Co.'s station that energy is sent to the distributing station on the bluff behind Victoria Park, 550 ft. to the rear of the power house and 250 above it. From this distributing station the current will be transmitted at a high voltage to Lockport, Rochester and Syracuse.

Following on the above, we come to the latest plant on the Canadian side—*i.e.*, that of the Electrical Development Co., which will have an ultimate capacity of 125,000 H.P., and some interesting particulars of which, together with the turbine illustration on page 886, were contained in a recent issue of the *Scientific American*.

This plant is also of the vertical shaft type, and eleven turbines, each of 13,000 H.P. at ¾-gate opening, will be installed in the wheel pit, which is 138 ft. deep. The hollow vertical shafts are 115 ft. long, each supported by three intermediate bearings, and terminating in a 9,375-KW. 12-pole revolving field type alternator, generating three-phase current at 12,000 volts pressure and 25 cycles.

The turbines are by the I. P. Morris Co., of Philadelphia, and they discharge alternately into tail races on either side of the wheel pit, which merge into a tunnel some 2,000 ft. long, driven under a portion of the Niagara River, and having its exit on the face of the cliff, behind the celebrated Horseshoe Falls.

The duplicate tail races will enable the company to shut down one-half of its plant for repairs if required, without interfering with the remainder.

TRAMWAY and RAILWAY NOTES.

(*Concluded from page* 882.)

Exeter.—The total revenue from the Corporation Tramways for the past year was £14,448, and the working expenses £8,048, leaving a net revenue of £6,400. After providing for interest and sinking fund, there remained a surplus of £2,020, of which £1,000 was put to reserve, £500 to the reduction of the rates, and £519 carried forward.

Glasgow.—The tramway financial year ended on Thursday last week, when a record balance, it is understood, was reported. A week ago the increase of receipts from passengers over last year amounted to fully £53,000, while the total drawings on the cars reached the remarkable sum of over £785,000.

Kingston-on-Thames.— On Saturday last three new sections of the London United Tramway Co.'s Surrey lines were opened for traffic—from Kingston to Ham, to the Kingston Gate and Richmond Park, and to New Malden.

London.—L.C.C.—The Highways Committee on Tuesday reported that difficulties had arisen in regard to the materials to be used for paving the tramway tracks on certain of the northern lines. In some cases the road authorities desired the use of wood paving, while from the standpoint of the satisfactory working of the tramways, the Committee considered it desirable to employ granite setts. As it had not been possible to arrive at an agreement by negotiation, the Committee proposed to take steps, as provided by Sec. 7 of the L.C.C. Tramways (Electrical Power) Act, 1900, with a view to the reference of the matter to the arbitration of a person nominated by the B. of T.

It is proposed to accept the offer of the London Electric Supply Corporation, amounting to £7,000, for the purchase of the two engines at the Loughborough Junction generating station as soon as the use of the plant has been discontinued. The company is also to purchase the plant temporarily installed by the Council at the Deptford station. A special meeting of the Council is to be convened to consider the question of acquiring the undertaking of the London Southern Tramways Co.

METROPOLITAN DISTRICT RAILWAY.—Major Pringle's report to the Board of Trade on the collision which occurred on March 22nd last at Minories Junction, near Aldgate Station, states that the derailment and subsequent collision were brought about primarily by the bad state of maintenance of the signalling arrangements at Minories Junction. No blame or responsibility was attached to the staff of either of the electric trains concerned in the collision.

Middlesex.—It was reported at the meeting of the County Council on May 24th that Messrs. Dick, Kerr & Co. had completed their contract for railway No. 2 (Priory Road and Turnpike Lane, Hornsey). The B. of T. had written stating that it was not at present prepared to consider any question of extension of time for completing the railways authorised under the 1903 order. If, however, the application was repeated about two months before December 30th next, it would be taken into consideration. In conclusion, the letter stated that the Board did not usually sanction an extension of a period limited for completing railways for longer than 12 months. It was agreed to pay the taxed costs of the Metropolitan Electric Tramways, Ltd., in connection with the recent action brought by the engineer against that company. Arrangements were made with the Southgate U.D.C. in connection with the reconstruction of King's Arm Bridge in connection with Railway No. 1 Order, 1903.

New Zealand.—WELLINGTON.—The City Council has decided to enter into agreements with the Karori and Miramar Borough Councils in respect to extending its tramway system in their areas. The Karori Council is to pay the city all costs and charges incurred in connection with the extension to its area. The borough is to construct the lines within its own boundaries, and will pay the Council the cost of keeping them in repair. The City Council agrees to run a service of cars at 1s. per car-mile. The agreement is for five years. The agreement with the Miramar Council is on similar lines, the borough service connecting up with the city lines at Kilbirnie. In regard to Onslow, the C.C. offers to run a service to this borough if the latter bears the cost of the feeder-cables required, and pays a charge not exceeding 1s. per car-mile. A new 1,000-H.P. E.C.C. generator and two new boilers are on the way out to supply power for these new suburban extensions.

The city finances for the last year of working show that the tramway revenue was £83,228, and the working expenses £58,429, and after providing for interest, sinking fund and depreciation, a net profit of £6,700 remains.

Rochester.—The new electrical tramway just completed for the city of Rochester was passed for use on Tuesday by the B. of T. inspectors, and on Wednesday was opened for public traffic. By this extension there will be a through route of some 6 or 7 miles, leading from the Grange, Delce, through Rochester and Chatham, and on to Gillingham; and as at present lines from Gillingham to Rainham are being laid down, ere long the routes will extend for another 5 miles. The Corporation of Rochester has constructed its own tramway lines, &c., but the cars of the Chatham and District Electric Railways Co. will run over the metals, by arrangement with the Corporation, and will pay a yearly sum for the use thereof. Workmen's cars will commence running from Delce to the dockyard at Chatham, and so on to the several naval and military stations in the town at 6.20 a.m., and after that cars will be run to and fro every 12 minutes. The fares are very low, especially to workmen, there being ½d. fares for certain distances. The whole distance from the Grange to the Chatham Town Hall is done for 1d.

Oxford.—The T.C. on May 23rd decided to invite tenders for leasing the tramway undertaking for the purpose of converting the system to electric traction.

Southport.—The annual report of Mr. Kendrew, the manager of the Corporation tramways, shows that the total traffic and other receipts (excluding, rent, &c., from the Southport Tramways Co., Ltd.) for the year amounted to £17,231, against £17,691 in the previous year, and £17,646 in 1903-4. The loss, as compared with the previous year, was £461, but this is, to a large extent, accounted for by the abnormal traffic during the visit of the Royal Lancashire Show in August, 1904. The gross working expenses amounted to £10,760, or £193 more than in the previous year. This increase is attributable to the fact that the cars ran an additional 14,399 miles, while the charge for power was £227 more. There is a gross profit for the year of £6,470, a decrease of £654, as compared with the previous year. The amount has been disposed of as follows:—£3,852, interest on loans; £3,269, sinking fund. There is thus a deficit of £655 on the lines worked by the Corporation, as against a profit of £15 in the previous year. During seven months of the year the cars are run at a loss. The manager expresses the opinion that if the tramways are to be a financial success, the desirability of running the cars on Sundays will have to be considered. Four years ago a ratepayers' poll was taken on this question, and "Sunday trams" were negatived by a large majority.

United States.—It is stated on the authority of the president of the Erie Railroad that it is the intention of the company to undertake at once the electrification of the branches from Rochester, New York, to Corning, and from Rochester to Mount Morris, as an initial step towards the electrification of a large portion of the Erie system. It is said that the Erie will obtain its power for operating the electric branches from the Niagara Falls Electrical Transmission Co., which is the American distributing concern for the Electrical Development Co. of Ontario. The cables which will convey this power from Canada to the United States will probably be carried across the river on the new trans-Niagara Bridge near the Falls, for the chartering of which Bills are now before the Parliaments of the Dominion of Canada, and of the United States.

TELEGRAPH and TELEPHONE NOTES.

Birmingham.—A new trunk telephone exchange, containing 25 switch sections and providing for 125 lines, as well as 20 spares for extensions, has been opened at the Central Post Office. There are at present 106 trunk lines and 102 junctions with the N.T. Co.'s system. The average number of calls received daily is 2,000.

Calcutta.—The Bengal Telephone Co., Ltd., has begun the replacement of the overhead wires by underground cables, involving the laying of 50 miles of cable in earthenware troughs filled up with bitumen, and resting on a concrete bed. All the exchange equipment is also to be reconstructed, the scheme, according to the *Times of India*, costing over 5 lakhs of rupees.

Canada.—The Railway Committee of the Canadian House of Commons has agreed to the proposal of the Bell Telephone Co. to double its capital in order to meet the growing opportunities for its enterprises. The Dominion Government intends to give the municipalities the power to designate what street shall carry the poles and lines of telephones, and any disputes are to be submitted to the Railway Commission for adjustment.

National Telephone Co.—The company has consented to receive deputations from the National Association of Telephone Operators to discuss the grievances of the staff. The step is regarded as important, as it constitutes official recognition of the operators' union.

New Cable.—According to the *Electrical World*, the United States Congress has now authorised the laying of a telegraphic cable between Key West, Guantanamo, Panama and Puerto Rico. The Bill was introduced by Congressman Wauger, and provides for the expenditure of $1,000,000.

Switzerland.—According to the *Bolletino delle Finanze* (Rome), trials have recently been made at Lausanne on the telephone line between Lausanne and Milan. The experiments, which have been very successful, have been made on the whole circuit Milan-Turin-Lausanne-Neuchatel-Berne-Lausanne, and the line will be immediately opened to service.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired
Trinidad-Demerara (No. 1.)	.. Aug. 26, 1901 ..	..
Dominica-Martinique	.. May 7, 1902 ..	..
St. Lucia-Martinique	.. May 7, 1902 ..	..
Reissa-Issa (Yemen) Camaran	.. Oct. 29, 1902 ..	..
Cayenne-Pinheiro	.. Aug. 18, 1902 ..	..
Port Arthur-Chifu (Closed)	.. Mar. 7, 1904 ..	..
Tarifa-Tangier	.. Jan. 18, 1904 ..	..
Tangier-Cadiz	.. Feb. 18, 1906 ..	..
Cayenne-Paramaribo	.. April 20, 1906 ..	..
Sydney-Nelson	.. April 26, 1906 ..	May 28
Cap Haitien-Puerto Plata	.. May 15, 1906 ..	May 29
Landlines.		
Puerto-Barrios	.. Aug. 28, 1902 ..	..
Bachkale-Deliman	.. Feb. 12, 1906 ..	..

Telephone Tariffs.—The Bureau International des Administrations Télégraphiques has published its second report on telephone tariffs, &c., the first having been published in 1894. The charges are given for Australia, Austria, Belgium, Bosnia, Bulgaria, Ceylon, Denmark, Egypt, France, French Indo-China, Germany, Great Britain, Greece, Holland, Hungary, Indies, Italy, Japan, Luxemburg, Madagascar, Norway, New Caledonia, New Zealand, Portugal, Portuguese Colonies, Roumania, Russia, Servia, Spain, Sweden, Switzerland, Tunis, and Uruguay. The price is 1.60 francs, and the cost of postage 80 centimes.

Underground Telephone Cables.—The American Telephone and Telegraph Co. is making trenches for telephone cables to operate between New York and Philadelphia. There will be provision for eight cables altogether, but it is only intended to lay one at first.

Alaska.—The British Vice-Consul at Seattle, in a recent report, states that the operations of the cable from Seattle to Alaska, which was completed and opened for business in September, 1904, have shown gratifying results, the receipts for 1905 being £25,971, with business showing an increase every month.

Wireless Telegraphy.—According to the daily Press, some interesting experiments in wireless telegraphy were commenced on May 29th by His Majesty's ships *Roxburgh*, *Good Hope*, and *Hampshire*, steaming off Newhaven; the *Triumph* and *Antrim*, lying at Chatham, and the *Endymion*, lying at Sheerness. The results are understood to have demonstrated the success of the new Admiralty system, which will prevent the interception of messages by an enemy.

The *Bollettino del Ministero delle Poste e Telegrafi* states that the Russian Government has decided to establish wireless telegraph stations at St. Petersburg and Moscow to facilitate communication between these two places.

The Wyoming *Tribune* states that the telephone system of Cheyenne has recently been rendered useless for several days owing to the signals from the wireless station at Denver, Colorado, being caught by the wires. Denver is distant about 100 miles from Cheyenne, and is said to employ a power of 50 KW.

CONTRACTS OPEN and CLOSED.

OPEN.

Clyde Navigation.—June 2nd. The Trustees invite tenders for the supply for one year of stores, including:—Asbestos and packing; electrical stores; india-rubber. Specifications on application to the Superintendent of Stores.

Colwyn Bay.—June 1st. Water-tube boiler, steam dynamo, condensing plant, for the Electricity Department. See "Official Notices" May 25th.

Dartford.—June 19th. Oils, meters, cut-outs, cable, general stores for one year for the Council. See "Official Notices" to-day.

Finchley.—June 11th. Water-softening plant for the U.D.C. electricity works. See "Official Notices" May 25th.

Handsworth.—June 5th. Electric wiring, fittings, &c., for schools and education offices for the U.D.C. See "Official Notices" May 25th.

Manchester.—June 12th. Stores for the Electricity Committee.

Nuneaton and Chilvers Coton.—June 12th. One 200-KW. steam dynamo for the U.D.C. See "Official Notices" May 25th.

Pontypridd.—June 4th. Paper-insulated feeder and pilot cables for the U.D.C. See "Official Notices" May 25th.

Portsmouth.—June 5th. 16 double-decked tramway motor-cars; also tramway feeder cables. See two "Official Notices" May 25th.

Roumania.—The municipal authorities of Forsani have just invited tenders for the concession for the electric lighting of the town.

Spain.—The municipal authorities of Valepenas (province of Jaen) have just invited tenders for the concession for the electric lighting of the town during a period of 20 years.

Torquay.—June 1st. Condensing plant for electricity supply extensions. See "Official Notices" May 18th.

Wimbledon.—June 20th. 12 "Flame" arc lamps and columns for the Corporation. See "Official Notices" to-day.

CLOSED.

Burnley.—The Electricity Committee has accepted the tender of Messrs. Yates & Thom for a new 30 ft. by 8 ft. Lancashire boiler.

G.E. Railway.—Messrs. Balcke & Co. have obtained an order from the Great Eastern Railway for one of their open type cooling towers, to deal with 300,000 gallons of water per hour, for their new power station at Stratford.

India Office.—The Lancashire Dynamo & Motor Co., Ltd., of Trafford Park, have received three orders from the India Office during the last few weeks, aggregating in all 67 motors, the major part of which are of the interpole type.

Leek.—The U.D.C. has accepted the tender of the Industrial Engineering Co., of Hyde, for the supply of a 120-KW. Campbell multi-cylinder gas engine, coupled to the company's own dynamo, at £1,899.

Leyton.—The U.D.C. on Tuesday referred the following tenders to the Electricity Committee for consideration:—

CAR BODIES.

Hurst, Nelson & Co., Ltd.	£16,400
Milnes, Voss & Co.	12,240
" " (amended tender)	12,400
Brush Electrical Engineering Co., Ltd.	12,600
Dick, Kerr & Co.	13,960
British Thomson-Houston Co.	12,600

RADIAL AXLE TRUCKS.

Brush Electrical Engineering Co.	£3,715
" " (alternative tender for 40 cars)	27,368
British Thomson-Houston Co.	3,715
Peckham Engineering Co.	3,848
Mountain & Gibson, Ltd.	3,667

ELECTRICAL EQUIPMENTS FOR, AND ASSEMBLING OF, CARS.

Raworths Traction Patents, Ltd.	£15,939
Brush Electrical Engineering Co.	11,853
British Thomson-Houston Co.	10,893
Dick, Kerr & Co.	12,238
British Westinghouse Co.	11,213

The D.C. on Tuesday accepted the following tenders for the annual supply of meters:—

Venner & Co.—Ordinary meters, size 1½, £1 12s. 6d.; 3, £1 16s.; 5, £2; 10, £2 5s.; 18, £2 10s.; 25, £2 10s.; 50, £2 14s.; 75, £3 3s.; 103, £3 3s.
Reason Manufacturing Co.—Slot meters, sizes 1½, 3, 5 and 10, £3 3s. each.

The Council has accepted the following tenders for the supply of coal to the E.L. department:—

Lockett & Judkins, London.—Hand-picked Linby small hard steam coal, 14s. 11d.; Bolsover small hard steam coal, 14s. 5d.
M. H. Abbott & Co., Bow Road, E.—Newstead small hard steam coal 14s. 10d.; Bestwood nutty slack, 9s. 10d.; Insdale nutty slack, 10s. 8½d.

The Electricity Committee are to make experiments as to the comparative value of the various coals, and will give their orders accordingly.

London.—POPLAR.—The Electricity Committee has provisionally accepted the following tenders for the supply of coal to the electricity works:—

Whitwell Coal Co.—Stockingford beans, at 12s. per ton, for 65 tons per week during the ensuing 26 weeks, the Council to have the option of supply of 130 tons per week during a further period of 26 weeks, at not more than 12s. per ton.
Spencer Whatley, Ltd.—Griff nuts, at 10s. 2d. per ton, for 2,000 tons to be supplied during the ensuing 12 months.
Charrington, Sells, Dale & Co.—Small Yorkshire screenings, at 10s. per ton, for 1,500 tons.

L.C.C.—The following tenders have been received for the execution of the roadwork and platelaying in connection with the reconstruction of the tramways between the Angel, Islington, and a point near Highbury station:—

R. W. Blackwell & Co.	(recommended)	£26,589
J. G. White & Co.		27,496
Dick, Kerr & Co.		28,064
J. Mowlem & Co.		30,039

The length of the tramways in question is about one mile of double track.

It is proposed to obtain from the British Westinghouse Co. the seven electrical equipments required for the seven car traversers for which the Council accepted the tender of Jessop & Appleby Bros. in April last. The work will be an extension of an existing contract, and the price is not to exceed £1,379.

Stoke-on-Trent.—The T.C. on May 24th accepted the following tenders for additional plant for the electricity works:—

Halpin & Co., thermal storage vessel, £533 10s.
Willans & Robinson, Ltd., steam set, £1,550; condensing plant, £547.
Morris-Hawkins Electrical Co., Ltd., balancer and booster, £300 16s.

War Office.—The War Office has placed a contract for the supply of "Cryselco" lamps for the next three years with Cryselco, Ltd.

REVIEWS.

Le Turbine a Vapore ed a Gas. By GIUSEPPE BELLUZZO. Milan: Ulrico Hoepli. 1905. Price 12 lire.

Engineer Belluzzo, the author of the work under review, is associated with the technical staff of the Milan Polytechnic. In a gracefully worded introduction he dedicates his work to Prof. Saldini, under whom he first studied the construction and application of turbines, an explanation being added that those of his readers who find cause of complaint against his book shall not, on that account, question his affection for his Professor.

A few short paragraphs give the substance of early experiments from 120 B.C. to the time when Watt in 1784 patented a turbine, followed soon after by many other turbine patents taken out by other engineers. But all were disappointed with the high speeds resulting, which were inapplicable to the purposes in vogue at that time, so that when Charles Parsons and Gustave Laval in 1884 commenced to achieve some success there were at least 150 records in the Patent Office of serious attempts in turbine design, though none had stood the practical tests of the requirements of the times. Such history, the author points out, is being repeated in regard to the gas turbine, which certainly cannot yet be considered a machine of practical utility: the study necessary, to approach in the gas turbine the perfection at which the steam turbine has arrived, is perhaps a more arduous one than has been undertaken by the pioneers of earlier prime movers.

For those who interest themselves in the question of "Entropy" the author offers some remarks, the explanation of which is accompanied by graphic representations of the relative values of the functions. This is followed by a full-page set of curves representing the properties of "dry steam," and a chapter devoted to the consideration of "superheated steam," the advantages of the latter being clearly shown by graphic methods with an absence of formulæ. Consideration is then given to the value of such gases as can be produced by the distillation or combustion of fuel, which mixed with air become heat agents; comparative results are worked out mathematically and represented graphically of the relative values under varying conditions. The theory of the flow of steam and gases through pipes and nozzles is dealt with, and to these notes are added copious references to international sources of detailed information on the different points. The first part of the work ends with numerical examples, which are calculated to show the application of the various theories given.

The second part is written on "graphic methods applied to the design of turbines" classified in two main groups:—(1) "Turbines with Single Distributors and Single Rotors;" (2) "Turbines with Multiple Rotors." Each group is sub-divided into "Continuous Action," "Intermittent Action," and "Reaction;" whilst any model can be operated "radially" or "axially" as expressing the direction of the steam jet relative to the shaft of the turbine. Diagrammatic sketches are given of each type. Consideration is given to the speed at which the best effect can be obtained, and the

Operators to discuss the grievances of the staff. The step is regarded as important, as it constitutes official recognition of the operators' union.

for schools and education offices for the U.D.C. See "Official Notices" May 25th.

corresponding losses occurring. In this connection it is pointed out that for driving electrical machinery the designer is compelled to give attention to certain definite speeds in order to maintain the "frequency," the range of possible speeds being controlled by the number of poles of the generator.

The "continuous-action" turbine can only be used for small powers; preference in this type is shown for an axial steam jet with a horizontal shaft. Carefully-prepared diagrams are shown to afford a comparison of the relative efficiencies under varying conditions of reciprocating engines and turbines, accompanied with extensive theoretical reasoning and mathematical deductions; the chief sources of loss in the turbine are given as due to the friction of the steam through the passages and nozzles, the losses caused by checking velocity of flow at the angles, and the abrupt changes of direction of flow. The author shows that these losses are most successfully combatted in the "reaction type with multiple rotors." In fairness to the reciprocating engine, it is admitted that it is reversible, and has a far greater range of speed within economical limits than is possessed by the turbine, though at "best speed" the latter now has distinct claims to superiority. Figures are given to show that a horizontal engine coupled to a 1,500-KW. alternator weighs about 146 kg. per KW., whereas a turbine and alternator of similar size weigh 57½ kg. per KW., and it is stated that for a 12,000-KW. size the combined turbine-alternator would be reduced to about 20 kg. per KW. Interesting comparisons are also shown of space occupied, foundations required, and oil consumption, the latter showing in favour of turbines to the extent of 60 or 80 per cent.

Considerations of the gas turbine are confined to theory. The four cycles known in connection with the reciprocating gas engines must be followed—viz., suction, compression, explosion, discharge. No simple arrangement of these functions has yet been mechanically devised, and the design is by no means an easy one; the compression will have to be done by some auxiliary agent, but by making a double-acting piston do the work the size need not be great in comparison with the rest of the machine, and further advantage on these lines would be gained where one compressor could be used to supply several gas turbines, whereby the cost represented by this plant might not be greater than the cost incurred in providing an air pump for the condenser of a steam engine or steam turbine. The author foresees the time when the gas turbine will be less expensive than the steam turbine, and will excel the best gas engine results that have been achieved.

The calculations given for the correct angles of the vanes of distributor and rotor afford substantial material for practical engineers engaged in this class of work, and should be of much use to the numerous firms who are now undertaking experimental work with a view to competing in this important industry.

The third part of the book is devoted to the criticism of various types of steam turbines in actual use—De Laval, Seger, A.E.G., Parsons, Rateau and Zoelly. In each case the general character is examined, the methods of regulation, the results obtained, some observations as to the improvements that have led up to the final design, and suggestions of further modifications that may prove desirable. Copious drawings of details and general arrangements are added to this portion of the work, which occupies nearly one-fourth of the volume, indicating that the author has expended considerable energy in this direction, as well as in the previous theoretical portions.

About 20 pages, forming the fourth part of the book, deal with the application of the steam turbine to marine work. The advantage is shown of the increased stability gained by the lowered centre of gravity; and in the case of warships, the absolute immunity from danger (the turbine being wholly below the water line), the economy of space and absence of vibration. The difficulty of reversing direction is got over by using a small additional turbine for this purpose, which has been designed by Parsons as an extension of the main turbine acting on the same propeller shaft. Drawings are given of vessels showing the relative positions occupied by the turbines, also tabulated results of trials.

The book forms a valuable addition to the Italian Technical Library: its useful effect is likely to be seen very soon in the work done by the national engineering firms whose usual custom is to found practice on theory, and who will not be slow to enter upon turbine work with the amount of information that Prof. Belluzzo's carefully written work places in their hands.

FORTHCOMING EVENTS.

To-day's Events (Friday, June 1st).—At 9 p.m. Royal Institution. Prof. H. Moissan on "L'Ebullition des Métaux."

Thursday, June 7th.—At 7 p.m. Junior Institution of Engineers. At Finsbury Technical College. Mr. R. P. Howgrave-Graham on "Electric Oscillation and Wireless Telegraphy."
At 8.30 p.m. Chemical Society. Meeting.

Friday, June 8th.—At 8 p.m. Physical Society. Mr. A. A. C. Swinton on "The Effect of Radium in Facilitating the Visible Electric Discharge in Vacuo." Mr. J. Goold's experiments with a vibrating steel plate, exhibited by Messrs. Newton & Co. Col. de Villamil on "Fluid (liquid) Resistance."
At 9 p.m. Royal Institution. Prof. Sir James Dewar on "Studies on Charcoal and Liquid Air."

Saturday, June 9th.—I.E.E. (Leeds). Visit to Harrogate Electricity Works. Meet Harrogate Railway Station at 3.15 p.m.

NOTES.

Glasgow and Electrical Time Service.—In May last year the Glasgow Corporation sent a sub-committee to the Continent to investigate the Normal-Zeit system of public time service adopted in Berlin, and also to make inquiries as to the systems in operation in other cities. These things the sub-committee duly did, and their full report has recently been placed before the Corporation. Electrically propelled and electro-mechanical clocks were fully investigated. The report makes interesting reading in that it gives a brief general summary of what has been done in Berlin, Antwerp, Brussels, Paris, London, Bremen and Stettin, and also in America, in this matter. The sub-committee invited tenders from certain firms, according to a certain specification, with a view to ascertaining the approximate cost of providing street clocks at 43 points within the city, representing 91 dials, also of connecting 32 existing turret clocks to the proposed clock system by means of a reporting back arrangement for recording the condition of these clocks, as well as the provision of a time indicator at each clock for synchronising purposes. It is estimated that, for such an installation as mentioned, with impulse clocks, the total cost would be £2,200 to £2,600, with from £400 to £550 for annual maintenance; for self-contained electro-mechanical (Normal-Zeit) clocks, the cost would be £4,900, with £690 per annum for maintenance. To connect the existing turret clocks electrically would cost £480, with £40 yearly for maintenance. The sub-committee points out, however, that the majority of the clocks are in so bad a condition that they will require to be either overhauled or discarded altogether. During their 30 years' working only two have been thoroughly overhauled.

Coming now to the sub-committee's general recommendations, we find that no system of public time service can be considered adequate "unless the citizens are enabled to participate in the benefits of the scheme by renting electrical clocks." This would mean the instituting of a new department, "which, for some years during its pioneering stage, might involve the city in a financial loss." The "business has no parallel in this country," and there are no reliable data available, therefore the opinion is expressed "that the supply of time service presents in itself peculiar features which afford reasonable grounds for believing that at first this enterprise should be conducted by a private company." It is further suggested that at present the public does not adequately realise the importance of a precise time service to such an extent as would justify the Corporation embarking on an enterprise "which would for some years be of an educative nature, in addition to performing its functions as a public utility." The sub-committee therefore recommends that the clock companies be asked to submit terms. It is pointed out that already certain private companies are taking steps to establish such services, "which will, in a short time, lead to the confusion of the public," and an early settlement is therefore urged. If the Corporation does not agree to the establishment of a complete public time service, nor give power to negotiate with the companies, the sub-committee asked for permission to arrange with either Messrs. Barr & Stroud or the Magneto Co. for an extension of their respective systems, as the Normal-Zeit system, if restricted to a small number of clocks, cannot be erected and carried on economically. The report is signed by Mr. John Macfee, the general manager of the Corporation Telephone Department, and Mr. Hugh J. Miller, convener of the sub-committee on clocks.

Appointments Vacant. — Engineer-in-charge (£117) for Southport; borough electrical engineer for Whitehaven (£250); jointer for Wishaw (35s.); rolling stock superintendent and works manager, for the Manchester Corporation tramways.

execution of the roadwork and platelaying in connection with the reconstruction of the tramways between the Angel, Islington, and a point near Highbury station :—

sketches are given of each type. Consideration is given to the speed at which the best effect can be obtained, and the

Power Generation at the Pit Bank.—A tendency has arisen in the industrial west of Germany to seek the financial co-operation of the municipal or communal authorities in the establishment of generating stations for the supply of a number of neighbouring districts. The latest scheme of this kind is that of the Westfalen Electricity Works Co., which is being formed by the banking firm of Hardy & Co., the Berlin Handels Gesellschaft and the Allgemeine Co., of Berlin. The Hibernia Mining Co.—one of the largest coal producing concerns—has been assured a participation of 25 per cent. of the share capital. The town of Bochum is offered 16 per cent. of the ordinary capital at the rate of 110 per cent. if the shares are taken up by July 1st, 1906, and at 120 per cent. if postponed until a period extending to July 1st, 1909. An allotment of 20 per cent. is granted to the other districts concerned, that is to say, Recklinghausen, Gelsenkirchen, Bochum, Hattingen, Witten and a part of the Dortmund district. The commune of Recklinghausen already has a supply agreement with the Hibernia Co., and this will doubtless be transferred to the Westfalen Co., the object of which is to furnish light and power to the localities previously mentioned on the modest share capital of £[illegible],000. It will, however, not be necessary for the company to erect and equip a generating station of its own, as the electrical energy will be supplied to it from the comprehensive plant installed on the property of the Hibernia Co., so that the new company will merely perform the duty of distribution. The Westfalen Co will in this way be furnished with from 3,000 to 4,000 KW. from the Hibernia pits' plant, and when the demand exceeds this power the company will either make arrangements with other collieries in the district for a similar supply or proceed to establish a generating station on its own account.

American Inquiry into British Municipal Ownership.—According to the *Standard* the tour organised for the Commission for the National Civic Federation of the United States, for the purpose of inquiring into the working of municipally owned tramway, gas and electricity undertakings, is as follows:—

May 30th.—Examination of Dublin tramways.
June 1st.—Glasgow electric lighting.
June 2nd.—Glasgow tramways.
June 4th.—Glasgow ironworks.
June 6th.—Newcastle District Electricity Co.
June 7th.—Newcastle gasworks.
June 8th.—Newcastle Electricity Supply Co.
June 11th.—Manchester electric lighting.
June 12th.—Sheffield gasworks.
June 14th.—Leicester gasworks.
June 15th.—Birmingham gasworks.
June 16th and 17th.—Liverpool electricity department.
June 18th.—Liverpool tramways.
June 19th.—Manchester tramways.
June 20th.—Manchester gasworks.
June 22nd and later days.—London tramway, gas and electric undertakings, with a trip to Norwich and possibly Bristol

The main body of commissioners will be preceded in the tour by a body of experts, who will, in each case, collect particulars.

Long-Distance Transmission in Switzerland.—After an investigation of various schemes for affording an extension of the local supply of light and power, the Zurich municipal authorities have decided to carry out a project for the utilisation of the water power of the Albula River which is to be dammed and the water led to a turbine-generator station on one bank of the stream. It is estimated that the expenditure on the works will amount to £428,000, and the scheme require from three to four years for its execution. Although the distance between the place of production and the centre of application is 86 miles, it is said that a decision has not yet been arrived at as to the use of the alternating or the continuous current system for transmission. The alternating-current scheme proposes the employment of four circuits having three wires in each and a pressure of 46,000 volts from the generating station. The direct current project contemplates a pressure of 79,000 volts, which will be reduced by one-half by the use of a double circuit. Both systems provide for the erection of watch-houses at distances of about 14 miles, which will be in telephonic and telegraphic communication with the generating station and the Zurich transforming station, and each 14-mile section will be regularly examined by the attendants permanently engaged in connection with the watch-houses, which will be combined with dwellings. A concession for 100 years has been granted by the canton of Grisons, in which the Albula River is situated, and where the power station will be built. The legal, geological and technical reports on the scheme have been prepared by Dr. Hoffmann, of St. Gall, Profs. Hennigs and Heim and Mr. Gisbert Kapp, and from these it would seem that no doubt exists as to the practicability of carrying out the project.

Electric Lead Smelting.—The first electrolytic method of reducing lead from its ores was proposed and patented by Swinburne in 1897. As an industrial process this was a failure, and no material advance on the original method was made until quite recently. Even now the problem has been solved by Betts and Valentine only by combining the older roasting process with the electrolytic arc. In their earlier work Anson G. Betts and Dr. W. Valentine attempted to electrolyse a solution of galena in a bath of fused lead chloride, in order to obtain thereby lead at the cathode and sulphur at the anode. In this manner many successful runs were made, but after a time the bath became choked up with the impurities of the ore and the process had to be abandoned. So far the method of procedure was almost identical with that described by Swinburne in his English patent of 1897. The problem then resolved itself into a preliminary removal of the gangue and the obtaining of such conditions as would prevent contamination of the reduced lead and clogging of the bath with such impurities as iron. Finally, the following method is given as a process capable of being worked on a commercial scale. The ore is first fused in an electric or reverberating furnace with a flux of limenite and limestone to remove such impurities as silica and obtain a matte rich in lead sulphide. This matte now contains practically the whole of the lead, together with about 10 per cent. of iron as impurity, but is almost free from other foreign matter. This is then run into the reduction furnace containing fused common salt. An iron casting imbedded in brickwork serves as cathode and at the same time as container. The anodes are of carbon or graphite, protected in their upper parts by a sleeve of fireclay and cement. At one side of the furnace is a well for the lead, at the other an outlet pipe for the sulphur vapour, and at the rear a tap for the matte. The lead finds its way through the cracks of the brickwork and establishes electrical connection with the iron cathode. External heating is used. A current strength of 10,000 amperes or over gives the best results, which require an E.M.F. of 2 volts. Neither the lead nor the iron sulphide of the matte dissolve in the bath of common salt, and as a consequence the dividing surface becomes the cathode and chlorine gas is liberated at the anode. At the same time lead is reduced and sodium sulphide formed. As this latter accumulates it forms a fusible double salt, with the iron sulphide and the sulphur formation commencing at the expense of the chlorine. In this manner a 96 per cent. yield of lead is obtained at the cathode and the remainder may be removed from the spent matte in the blast furnace. No lead is lost by volatilisation, and very nearly the whole of the sulphur is recovered. In this process the estimated economy is about 12s. per ton of matte.—*Electro-chemical and Metallurgical Industry*, May, 1906.

The Irish Canals and Electric Traction.—Should the schemes of electric traction on the waterways and canals of the United Kingdom mature, a great field will be open in Ireland. That country is intersected by a network of canals and channels on the Dutch principle. King William the Third, whilst in Ireland after his victory at the Boyne, conceived the project of making Ireland another Holland by a system of canals. Immense sums of money were expended in subsequent years, but the Irish did not appreciate the canals, or do anything to develop them, except in the thrifty north. Many of the canals are derelict and of no service to any person. In any case, they never repaid the capital sunk in them. The excessive rates for carriage by rail in Ireland should tell in favour of the electrically-hauled lighters and barges, should the scheme ever come to fruition.

Pontypool's Peril.—Poor Pontypool must be in a bad way. The Welsh revival can hardly have been successful there, for if reports be true the town is in imminent peril—it may be blown up at any moment. Then would the survivors wear sackcloth and ashes, indeed. One of its councillors last week said—we *never* dispute what a councillor says—that its streets were full of current, and the surveyor remarked that even the horses kick at it and settle on their haunches. The leakage is reported to have been going on for months, and the Pontypool Electric Light and Power Co. has had to open the streets at many points (to let it out ?). Do the papers that have made this sensation the text for paragraphs headed "Freaks of Electricity," "Electrical Street Dangers," and so forth, know how much gas there has been saturating the soil wherever a gas supply exists—not "for months" but for years and years ? One of the items in this Pontypool scare is the explosion of gas which had found its way into an electric light culvert.

Practical Electro-Technical Manual.—The popular school of Electro-Technics, of Turin, is offering a prize of 2,000 lire for an easily-understood work on electro-technical matters suitable for working men. It is suggested that fundamental principles should be treated and attention given to experimental results, but avoiding the use of formulæ. Competitors should send in their work not later than April 13th, 1907, to the Popular School of Electro-Technics, 128, Corso Regina Margherita, Turin ; the commission is authorised to award a second prize of 500 lire.

Electrolytic Disinfectant.—A demonstration of the manufacture of electrolytic disinfectant was given last week under the supervision of the Medical Officer of Health of Poplar, Dr. Alexander. By this means it is claimed that a disinfectant is produced which is not only far cheaper than others, but even more effective. It is stated that 185 gallons of powerful antiseptic fluid can be produced in eight hours at a cost of less than a penny a gallon. We shall deal fully with the matter in our next issue.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station Engineers.—On Thursday evening, 24th ult., the staff and employés of the Ealing Corporation Electricity Department held their fourth smoking concert at the works. The chair was taken by Mr. J. Douglas Knight,

Technical Library: its useful effect is likely to be seen very

jointer for Wishaw (35s.); rolling stock superintendent and works manager for the Manchester Corporation tramways.

borough electrical engineer. The event of the evening was the presentation to Dr. ARTHUR, M.B.Ch., of an ophthalmascope in case, a Standard personal weighing machine and height measurer, and a case of surgical needles, on behalf of the 30 members of the Ambulance Class, as a token of esteem and affection. Dr. Arthur gave the whole of his lectures gratuitously. The interval was occupied by various members trying their weight on the Doctor's weighing machine.

The Battersea B.C. has appointed Mr. ARTHUR FREDERICK BOND, of Heston and Isleworth, as its chief electrical engineer at £500 per annum.

Mr. W. LUNN has resigned his position as outside engineer to the Lowestoft Corporation Electricity Supply Department, to take a position in the cable department of Messrs. Siemens Bros. & Co., Ltd., London. He was presented with an engraved silver match box from his late staff.

Mr. PERCY E. RYCROFT, chief assistant at Islington electricity works, has been promoted to the position of deputy-engineer at the increased salary of £350 per annum. In moving the recommendation, the chairman of the Electricity Committee spoke very highly of the economies which Mr. Rycroft had effected in the works.

Mr. P. J. WATTS, borough electrical engineer at Whitehaven, has resigned his position, he having accepted an appointment under the Admiralty.

On Wednesday, May 30th, at the Brompton and Kensington Electricity Supply Co.'s station, Mr. W. WHITIE, the works engineer, was made the recipient of a handsome canteen and congratulatory address on the occasion of his approaching marriage. The manager (Mr. Henry W. Bowden), in making the presentation, referred to Mr. Whitie's long association with the company (17 years), and the goodwill and esteem in which he is held by all members of the staff.

Tramway Officials.—Mr. A. A. HAWKINS, tramway manager, Greenock, has been appointed general manager of the Wrexham and District Tramway Co.

General.—On Thursday last week the members of the Sheffield Corporation electric supply department assembled at the Lady's Bridge Hotel to do honour to Mr. J. W. BEAUCHAMP, the deputy manager of the undertaking, on the occasion of his approaching marriage. A case of Sheffield cutlery was subscribed for by the staff and workmen of the department, and in handing over the presentation, Mr. Fedden, general manager and engineer, spoke in eulogistic terms of Mr. Beauchamp's worthy service to the Corporation and valuable assistance to himself. Mr. Beauchamp suitably responded. The remainder of the evening was given up to a smoking concert, songs, recitations, &c., being rendered by various officials.

Mr. JOHN MURPHY, electrical engineer, of Ottawa, has been appointed consulting electrical engineer to the Government of the Dominion of Canada. The appointment (says our Toronto correspondent) is generally popular, it being felt that Mr. Murphy's long and successful career eminently fits him for the position. In addition to being retained for special services by power owners and electric railway companies in different parts of Canada, Mr. Murphy designed the electrical equipment at the extensive works of the Locomotive and Machine Co. at Montreal, which is said to be the most completely equipped plant in America. Every tool in these works is electrically driven. During the past winter Mr. Murphy succeeded in keeping the plant of the Ottawa Electric Co. in perfect working order at times when all the other water power plants in the neighbourhood were either badly demoralised or shut down altogether by frazil. This was accomplished by means of a process which he has patented. Mr. Murphy is vice-President of the Canadian Electrical Association, an associate member of the Canadian Society of Civil Engineers, and a member of the American Institute of Electrical Engineers.

Mr. W. H. SHINN has been transferred from the Engineer's Department of the National Telephone Co., Ltd, Glasgow, to London, and has been presented with a gold watch and pendant by the members of the staff.

NEW COMPANIES REGISTERED.

Amalgaline, Ltd. (88,856).—This company was registered on May 22nd, with a capital of £1,100 in 1,000 preference shares of £1 each and 2,000 ordinary shares of 1s. each, to acquire certain inventions relating to improvements in the jointing of cables, pipes, rods, tubes and the like, in a flux therefor, and in moulds for the metallic covering of joints in lead-covered cables, to adopt an agreement with T. Harden and S. L. Smith, to develop and turn to account the said inventions, and to carry on the business of founders, engineers, manufacturers of lead pipes, makers of electric light and other cables, &c. The first subscribers (each with one share) are:—T. Harden, 62, Hurlingham Road, S.W., electrical engineer; J. A. White, 41, Holborn Viaduct, E.C., solicitor; R. Manhire, 19, Anhalt Road, Battersea, S.W., clerk; E. J. Taylor, 41, Holborn Viaduct, E.C., clerk; T. S. Dangerfield, 19 and 20, Holborn Viaduct, E.C., surveyor; D. Judd, 22, Chesholm Road, Stoke Newington, N., law stationer; and C. S. Krauss, 25, Palace Court, W., articled clerk. No initial public issue. The number of directors is not to be less than two or more than five; the first are J. White, T. S. Dangerfield and S. L. Smith. Registered office, 41, Holborn Viaduct, E.C.

Matthews' Improved Electricity Meter, Ltd. (88,909).—This company was registered on May 24th, with a capital of £2,500 in £1 shares, to adopt an agreement with S. Matthews, and to carry on the business of manufacturers of and dealers in electricity meters and other instruments and appliances, electric and general engineers, &c. The first subscribers (each with one share) are:—C. C. Cannell, Blomfield House, E.C., merchant; P. Matthews, 35, Bucklersbury, E.C., surveyor; H. H. Matthews, 35, Bucklersbury, E.C., surveyor; A. Goodman, 35, Bucklersbury, E.C., valuer; J. Hewett, 5, Budge Row, E.C., engineer; W. H. Matthews, 32, Queen Victoria Street, E.C., solicitor; and F. J. Dickson, Blomfield House, E.C., solicitor. No initial public issue; the number of directors is not to be less than two or more than five; S. Matthews is one of the first; qualification, 100 shares; remuneration as fixed by the company. Registered office, 35, Bucklersbury, E.C.

Andrews & Mumford, Ltd. (88,836).—This company was registered on May 21st, with a capital of £2,000 in £1 shares, to adopt an agreement with C. B. Andrews and W. J. Christison, and to carry on the business of electricians, electrical, mechanical and general engineers, makers of electrical tramcars, motor-cars, carriages and other vehicles, manufacturers of and dealers in dynamos, batteries and other electric apparatus, &c. The first subscribers (each with one share) are:—C. B. Andrews, 7, Mount Pleasant Road, Catford, chemical apparatus manufacturer; W. J. Christison, 81, Lyndhurst Road, Peckham, S.E., chemical apparatus manufacturer; R. R. Mumford, 3, Budge Row, E.C., general merchant; S. C. Andrews, 7, Mount Pleasant Road, Catford, chemical apparatus manufacturer; K. W. Mumford, Kirby Lodge, Hardy Road, Westcombe Park, S.E., clerk; Miss B. M. Mumford, Kirby Lodge, Hardy Road, Westcombe Park, S.E.; and Miss W. Mumford, Kirby Lodge, Hardy Road, Westcombe Park, S.E. No initial public issue. The number of directors is not to be less than two or more than five; the first are C. B. Andrews, R. R. Mumford (managing directors), and one other to be appointed by the debenture-holders. Registered office, 1, Leather Street, Camberwell, S.E.

National Construction Co., Ltd. (88,910).—This company was registered on May 24th, with a capital of £60,000 in £1 shares, to acquire and turn to account any contracts, rights, grants, concessions, &c., relating to land, railways, tramways, roadways, waterways, British and Colonial Government contracts, electrical generation, traction and supply, buildings, harbours, docks, naval and military works, canals, timber, transportation, lighting, &c., in any part of the British Empire. The first subscribers are:—Sir Henry W. Tyler, Kt., Linden House, Highgate Road, N.W., 1,000 shares; F. H. Houlder, Queen Anne's Mansions, S.W., shipowner, 1,000 shares; J. Matthews, Lemington Hall, Lemington-on-Tyne, engineer, 1,000 shares; C. Earle, 74, Beverley Road, Hull, manufacturer, 500 shares; F. Jefferies, 242, Evering Road, Upper Clapton, N.E., merchant, 500 shares; A. Jefferies, 11, Sanford Terrace, Stoke Newington Common, N., merchant, 500 shares; and F. H. Pepper, 3 and 4, Clement's Inn, Strand, W.C., solicitor, 200 shares. No initial public issue; the number of directors is not to be less than three or more than nine; the subscribers are to appoint the first; qualification, 50 shares; remuneration as fixed by the company. Registered office, 52, Queen Victoria Street, E.C.

Siemens Brothers' Dynamo Works, Ltd. (88,928).—This company was registered on May 25th, with a capital of £300,000 in £10 shares, to acquire as from January 1st, 1906, the dynamo branch of the business of Siemens Brothers & Co., Ltd., hitherto carried on by them as telegraph and general engineers, electricians, contractors, merchants and manufacturers at Stafford and York Mansion, Westminster, S.W., to take over the assets and obligations of the said company so far as the same relate to the said Stafford works and the said London office, to continue such dynamo business, and to enter into arrangement with Siemens-Schuckertwerke G.m.b.H. (Berlin), with regard to the management of the company's undertaking. The first subscribers (each with one share) are:—A. Siemens, Westover, Milford-on-Sea, Hants, civil engineer; C. F. von Siemens, 12, Queen Anne's Gate, Westminster, civil engineer; G. von Chauvin, Jesmond, Bromley, Kent, telegraph engineer; B. H. Antill, 12, Queen Anne's Gate, S.W., civil engineer; A. Sabine, 12, Queen Anne's Gate, S.W., secretary; W. H. Stafford, 43, Granville Park, S.E., accountant; and P. G. Ledger, The Cottage, Court Road, Eltham, Kent, electrical engineer. No initial public issue. The number of directors is not to be less than three or more than eight, the first are A. Siemens, C. F. von Siemens, G. von Chauvin, Dr. A. Berliner and H. Natalis. No qualification required; remuneration (if any) as fixed by the company. The board may increase the capital up to a further £500,000.

H.P. Syndicate, Ltd. (88,942).—This company was registered on May 26th, with a capital of £12,500 in £1 shares, to adopt an agreement with M. F. Armstrong and H. W. Fox, and to carry on the business of suppliers of electricity for light, heat, motive power, or otherwise, electricians, engineers, manufacturers of and dealers in electrical apparatus, mechanical engineers, waterworks proprietors, colliery owners, &c. The first subscribers are:—A. Scott, 4, Austin Friars, E.C., stockbroker, 250 shares; P. S. Inskipp, 2, London Wall Buildings, E.C., gentleman, 1 share; H. H. Hitchcock, 44, Home Park Road, Wimbledon Park, clerk, 1 share; W. Watkins, 62, London Wall, E.C., chartered secretary, 1 share; C. H. F. Ambler, 25, Woodland Rise, Muswell Hill, N., engineer, 1 share; F. H. Becher, 34, Fenchurch Street, E.C., merchant, 25 shares; and A. H. Wale, 701, Salisbury House, London Wall, E.C., chartered secretary, 1 share. No initial public issue. The number of directors is not to be less than two or more than five; the first are H. W. Fox and M. F. Armstrong (life directors, special qualification 500 shares), P. S. Inskipp, F. H. Becker and A. Scott; remuneration, one guinea each per board meeting attended and 5 per cent. of the net profits available for distribution divisible. Registered office, 701, Salisbury House, London Wall, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Okonite Co., Ltd. (69,327).—This company's annual return was filed on April 25th, when 32,000 preference and 16,000 ordinary shares had been taken up out of a nominal capital of £120,000 in 32,000 preference and 16,000 ordinary shares of £2 10s. each. £2 10s. per share has been called up on 100 ordinary and 110 preference shares, resulting in the receipt of £525. £119,475 is considered as paid on 47,790 shares. Mortgages and charges: £57,200, of which £35,200 debentures are in the hands of trustees for the company.

Winchester Electric Light and Power Co., Ltd. (50,868).—This company's annual return was filed on May 15th, when 8,200 shares had been taken up out of a nominal capital of £50,000 in £5 shares. £41,000 has been received. Mortgages and charges: £39,700.

Lancashire United Tramways, Ltd. (87,044).—Memoranda of satisfaction in full (*a*) of a debenture dated February 15th, 1906, securing £37,702 0s. 9d., and (*b*) of a debenture dated March 14th, 1906, securing £20,346 10s. 4d., have been filed.

Lancashire United Tramways, Ltd. (87,044).—A trust deed dated April 27th, 1906, to secure £300,000 debenture stock, redeemable at 5 per cent. premium (optional), has been registered. Property charged: Freehold and leasehold land at Hindley and Atherton, Lancashire, with the generating stations and other buildings thereon; 12,123 fully-paid shares of £10 each, 40,509 £10 shares (£5 paid) and 27,577 £10 shares (£6 paid) in the South Lancashire Tramways Co., Ltd.; the interest of the company (if any) in 29,730 £10 shares upon which nothing has been paid, and 49,637 fully-paid shares of £1 each in the Lancashire Light Railways Co., Ltd.; and the company's other assets, present and future, including uncalled capital. Trustees: J. W. Philipps, M.P., 23, Albemarle Street, W.; and B. Snell, 5, Copthall Buildings, E.C.

J. G. Wills & Co., Ltd., ironmongers and electrical engineers, Weymouth (84,870).—Issue on March 22nd of £50 debentures, part of series created October 15th, 1905, to secure £1,500, charged on the company's property, present and future, except uncalled capital. No trustees. Previously issued of same series, £375.

Synchronized Electric Clock Co., Ltd., Leamington (79,362).—Particulars of £2,500 debentures, created by resolution of November 10th, 1905, charged on the company's undertaking and property, present and future, have been filed pursuant to Section 14 (4) of the Companies Act, 1900. No trustees.

National Electric Construction Co., Ltd. (53,364).—This company's annual return was filed on April 25th, when 147,863 shares had been taken up out of a nominal capital of £250,000 in £1 shares. £129,012 has been received, and £18,851 is considered as paid. Mortgages and charges: Nil.

Northern Counties Electricity Supply Co., Ltd. (67,924).—This company's annual return was filed on April 12th, when 150,000 shares had been taken up out of a nominal capital of £200,000 in £1 shares. £1 per share has been called up on 146,000, and £145,968 15s. has been received, leaving £31 5s. in arrears. 4,000 shares are considered as fully paid. Mortgages and charges: £100,000.

St. James' and Pall Mall Electric Light Co., Ltd. (26,015).—This company's annual return was filed on March 15th, when the entire capital of £800,000 in 40,000 ordinary, and 20,000 preference shares of £5 each had been taken up, £5 per share has been called up on 39,650 ordinary, and 20,000 preference shares, resulting in the receipt of £298,250. £1,750 is considered as paid on 350 ordinary. Mortgages and charges: £150,000 3½ per cent. debenture stock, and £168,488 guaranteed debenture stock of the Central Electric Supply Co., Ltd., being half the total loan capital.

Traction Co. of the United Kingdom, Ltd. (Westminster).—A memorandum of satisfaction in full of a charge dated December 23rd, 1902, and March 2nd, 1903, securing £3,000, has been filed.

New Electric Rifle and Target Co., Ltd. (London) (87,477).—A debenture dated May 4th, 1906, to secure £700, charged on the company's property, present and future, including uncalled capital, has been registered. Holder: P. L. Jacques, Silsden, near Keighley, Yorks.

CITY NOTES.

Rand Central Electric Works.

Sir C. RIVERS WILSON presided on Tuesday at Winchester House over the meeting of this company. In moving the adoption of the report, he said that the gross earnings for the year 1905 were £702,824, against £96,180 in 1904, an increase of £16,644. The work done showed an increase of 422,000 KW.-hours, or 4 per cent. To obtain those satisfactory results had only cost an increase of £407 in expenses; this was due to the care of their general manager and his staff, and to the improvement of the plant. Mr. Spengel hoped to be able to effect even more considerable reductions during the current year. The working profit was £54,410, an increase of £2,959. In the balance-sheet an increase of £10,000 odd had been charged for construction of works, machinery, and plant generally. £4,500 of that was for the new 400-KW. steam turbine, and the rest was for additional machinery, new locomotives for coal haulage, &c. A new arrangement had been made with the company for water supply, which was now expected to be ample for years to come. The cash at bankers had increased by £24,500; at December 31st last it amounted to £99,488, and at the present moment the cash resources were £115,700; so that, after payment of the dividend, they had £93,200 available. That included an amount accumulated for depreciation and available for providing the new plant they had in contemplation. This put them in a strong position, because the amount represented so much less capital to be called up when they had to set to work seriously to increase their plant. In the profit and loss account there was an item of £777 paid as royalty to the Transvaal Government under the concession. He mentioned last year that they were in friendly discussion with the Government as to the interpretation which should be placed upon their arrangement, by which they had to pay them a royalty of 2½ per cent. upon the net profits of the undertaking. The question was raised by the Government as to whether net profit should be struck before or after depreciation had been allowed for. They thought there was no doubt that depreciation should be taken into consideration, and the royalty paid only on net profit after deduction for depreciation. The Government had adopted that view, so that in future they would pay only on net profits. They proposed to set aside £24,097 to the renewal account, set up in substitution of the old depreciation account. The amount hitherto set aside for depreciation had this year been utilised for a renewal fund, and the directors had set aside a sum in excess of any previous year, so as to be in a position to rapidly replace the present plant by more modern machinery, which, together with the contemplated extension, would enable the company to successfully compete with any rival scheme. That matter and the technical questions in connection with it were now being examined by experts of the highest standing. Mr. Gorrissen, one of the directors of the company, who was for several years their managing director out in South Africa, and who had an intimate knowledge of the conditions on the Rand, had gone out specially to examine the whole question. They would be able successfully to hold their own. They had now four engines in full operation, and, together with the new steam turbine, they had a total capacity of 3,200 KW. They had always gone on the principle of keeping one engine in reserve, but this they found it difficult to do until they added the steam turbine. The normal capacity in operation should be 2,500 KW., but, as a matter of fact, in June last the maximum was 2,580 KW. Some of their important contracts were continually falling in, and the most important was that for the supply to Johannesburg municipality which would come to an end during this year. They had been taking steps to fill up the gap which would be thus created. Several new contracts had already been made which would take a very considerable amount of the supply to be provided for, and other contracts were at present in negotiation. Therefore, they had not the smallest apprehension that there would be any intermission of business. Their contract with the Government might run out in 1909. It was open to the Government to expropriate them at the end of that time, but their local board was in negotiation with the Government with a view to obtaining an extension of the concession, and they were now discussing the terms of the extension. They had very little doubt that they would be able to obtain a new and still more favourable concession than they enjoyed at present. They had to consider very carefully how to deal with the question of dividend, and they came to the conclusion that they would be acting in the best interests of the company in not forcing the pace too much, but in view of possible fluctuations which were incidental to a great industry like theirs, they should maintain a very conservative policy. They proposed, therefore, to distribute £22,500 in payment of a 7½ per cent. dividend, carrying forward £12,338. Their position was very strong, and their prospects very satisfactory. Their progress was continuing in the present year, for, up to the end of April, their receipts were £4,300 in excess of those of last year.

Mr. GEO. VON CHAUVIN seconded the motion, and it was adopted.

The dividend resolution was approved, the retiring directors and auditors were re-elected, and a vote of thanks closed the meeting.

West African Telegraph Co.

THE directors' report for 1905 says that the revenue for the period amounted to £65,846, from which is deducted £15,732 for the ordinary expenses, and £13,275 for expenditure relating to maintenance of cables, leaving a balance of £36,839, to which is added £1,676 brought forward from the preceding year, making a total available balance of £38,516. The sum of £1,762 has been provided for income-tax, £26,000 has been transferred to general reserve fund, and an interim dividend of 2 per cent., absorbing £4,622 was paid on December 1st last. The directors recommend a final dividend of 2 per cent. (free of income-tax), making, with the interim distribution, 4 per cent. for the year, the balance of £1,511 being carried forward.

The meeting was held yesterday.

Water-Tube Boiler Amalgamation. — Yesterday's financial papers stated, on the authority of a Glasgow correspondent, that the directors of Babcock & Wilcox, Ltd., and Stirlings, Ltd., have formulated a scheme for a fusion of both companies. Stirling shareholders are to receive three Babcock & Wilcox shares for each Stirling share held.

Companies Struck Off the Register.—The *London Gazette* contains official intimation that the following companies have been struck off the register, and are accordingly dissolved:—

Associated American Electrical Manufacturers.
Bee-Bee Electrical Engineering Co.
British Smoke Consumer Co.
"Commerce" Publishing Co.
Crankless Engine, Ltd.
Dynamic Gas Power Co.
Greaves Boiler Tubes Syndicate.
Harbourne Electrical Manufacturing Co.
Industrial Electric Co.
Paris Singer Electrical Carriage Co.
Peking and North China Electrical Corporation.

Prospectuses. — *Bruce Peebles & Co., Ltd.* — This company is inviting applications until to-day for 8,951 ordinary shares of £5 each at par. This issue is needed for working capital purposes owing the rapid growth of the business.

South Metropolitan Electric Tramways and Lighting Co., Ltd.—The list was to close yesterday in an issue of £150,000 4 per cent. debenture stock at £90 per £100, also of 150,000 6 per cent. cumulative preference shares of £1 each at par, offered by the Electric and General Investment Co., Ltd. The company is interested in electric tramway and light railway undertakings in Penge, Croydon, Sutton and Mitcham, and owns the Sutton, Carshalton, Wallington and Epsom Electric Lighting Orders. Operations are already proceeding, in some cases supply, in others constructional, in connection with these, and profit is already being earned. The tramway and light railway concessions will be transferred from the B.E.T. Co.

The Gearless Motor Omnibus Co., Ltd.—The list of applications was to close yesterday in an issue of 215,000 £1 ordinary shares at par. The object of the company is to run motor-'buses in London and suburbs on the Auto-Mixte system, which was fully described in our issue of May 4th.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—This company has recently been before the public with an issue of 12,500 ordinary shares (£5 each) at a premium of £2, and 12,500 £5 preference shares at 10s. premium. Large extensions are proceeding at Carville, and it is in connection with these, and the general development of the system throughout the company's area, that the issue is required. It is stated that, in addition to the normal increase, two big consumers have been secured who together will require about 30 millions of units annually in the immediate future. Last year the total units sold exceeded 30¼ millions. It was stated on Saturday last that the issue was over-subscribed, and that the directors had closed the list.

MARKET QUOTATIONS.

Wednesday, May 30th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£20	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10½d.	..
a ,, (50 %)	per gal.	10d.	..
a Copper Sulphate	per ton	£26	..
a Lead, Nitrate	per ton	£28	£1 inc.
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	200/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	2½d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£160	..
b ,, Wire, in ton lots	per ton	£191	..
b ,, Sheet, in ton lots	per ton	£177	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	9½d.	..
c ,, Tube (brazed)	per lb.	11½d.	¾d. inc.
c ,, ,, (solid drawn)	per lb.	10¼d.	¾d. inc.
c ,, Wire, basis	per lb.	9¾d.	..
c Copper Tubes (brazed)	per lb.	11½d.	..
c ,, ,, (solid drawn)	per lb.	11½d.	..
g Copper Bars (best selected)	per ton	£100	..
g Copper Sheet	per ton	£100	..
g ,, Rod	per ton	£100	..
e ,, (Electrolytic) Bars	per ton	£92	..
e ,, ,, Sheets	per ton	£104	..
e ,, ,, Rod	per ton	£95	..
e ,, ,, H.C. Wire	per lb.	11d.	..
f Ebonite Rod	per lb.	3/3	..
,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/7	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/2 to 5/3	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	50/-	7½d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£17 to £17 2 6	12/6 dec.
g ,, ,, Sheet	per ton	£18 17 6 to £19	12/6 dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot	£7 5	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	91/6	..
e Silicium Bronze Wire	per lb.	1/- to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars	per ton	£15 to £40	..
g Tin, Block (English)	per ton	£185 to £186	..
n ,, Wire, Nos. 1 to 16	per lb.	2/2	4d. dec.
p White Anti-friction Metals— "White Ant" brand	per ton	£46 to £70	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5⅝d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4½d.	..
j ,, 10 lbs. Russian, single	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£32	35/- inc.

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
j Walter H. Hindley & Co., Ltd.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Stock Exchange Notices. — The Committee has appointed a special settling day as under—

Wednesday, June 12th.—Marconi's Wireless Telegraph Co.—Further issue of 5,000 shares of £1 each, fully paid, Nos. 251,128 to 256,127; and 128,063 shares of £1 each, 15s. paid, Nos. 256,128 to 384,190.

And has ordered the same securities to be quoted in the Official List.

Mexico Electric Tramways, Ltd.—This company's annual meeting was held at London Wall Buildings on 23rd ult., Mr. L. Breitmeyer presiding. The report was adopted after lengthy criticism and opposition from Mr. A. Parrish.

STOCKS AND SHARES

Wednesday Afternoon.

WHITSUN's approach serves as the present excuse for quietude in Stock Exchange business. The Electrical markets, it must be frankly admitted, are out of popular favour for the time being, and this applies more especially to the electric lighting and the railway companies.

Animation in the Telegraph sections has narrowed to gambling in Anglo-American Deferred, while the state of the electrical trade militates against much buoyancy being displayed in manufacturing companies.

Some of the new issues forecast in our last week's notes are now before the public. Bruce Peebles offers 8,951 Ordinary shares of £5 each at par, and the price of the existing Preference has slipped back to 5, as one consequence. An interesting new issue is that of the South Metropolitan Electric Tramways. It is launched at a somewhat unpropitious period, because the public are shy of applying for such speculative propositions. The company will have to create a great deal of traffic before there is much likelihood of adequate return upon the capital, and while it is often true that facilities for travelling do create business, the preliminaries may be long and unremunerative. It is a singular coincidence that London United Tramways Preference should have risen to 9¼ upon the appearance of the South Metropolitan prospectus, but it would need no imaginative gift to link the two. City and South London stock is also better, to the extent of a point, and a trifling demand for Great Northern and City Preferred "A" shares has again raised the price 5s., making it 4, as against 3½ in the middle of May.

These railway movements, however, were entirely dwarfed in interest by the renewed outbreak of flatness in Metropolitan Consolidated stock. The price fell to 66 upon the news, officially communicated, that the rent receivable by the company in respect of the Great Central and Metropolitan joint line has been included in the published traffic returns. This perhaps was less unexpected than interested quarters endeavoured to make the newspapers believe, but the confirmation of the fears well nigh demoralised the market at one time. Subsequently there was a recovery to 67½. Metropolitan Surplus Lands are down to 71, and Districts, though the line is entirely unaffected by the Metropolitan intelligence, relapsed to 24, to advance again this Wednesday to 25.

Continuing the subject of traction finance, it must be noticed that British Traction Ordinary and Preference are both ⅛ up, which brings the price of the latter within sight of its par value of £10. British Westinghouse Preference are ⅛ duller at 2 middle. The last time that the unfortunate shareholders received a dividend was in February, 1904. The Debenture interest has been regularly met.

Electric lighting shares have no advance to report, but Urban Ordinary are ¼ lower at 4; in which connection the interpolation may possibly be forgiven which will clear the writer from the credit of a remarkable statement in last week's issue with regard to Urban shares and the general market. Rubbish, intentionally written, is a luxury not permitted here.

(In last week's article, lines 10, 11 and 12 should have read: "The recent report is responsible for this weakness. Of the Metropolitan Companies' shares, Charing Cross City Undertakings are flat at 4," and so on.)

By rapid strides the price of Anglo "A" is getting close to that figure of 30 tipped by the market some time ago as the probable goal of the stock. The price is up a full point at 27¼, and people who thought the pace too hot to last (if a sporting expression be allowable this week) are wavering in their belief as to an early reaction. The Preferred stock has gained ½ at 115, but the Ordinary sticks at 68, and were it not for the unnegotiability of the stock, we should feel inclined to suggest a coming advance. There is but £700,000 of Anglo Ordinary, and it would take very little buying to put up the price three or four points. Of course, the stock is quite a speculation. West India and Panama First Preference are down 15s., following the fall for which reasons have already been given. The weakness in "China" shares is difficult to account for. Both the pre-ordinary stocks of the Eastern Co. are a point better. Direct United States shares steadied to 16, and West Coast of America Debentures are 1 up. National Telephone issues are featureless, and no alteration has occurred in any of the other telephone companies' shares. A precisely similar remark covers the manufacturing list, except for the changes already noted, and a touch of weakness in Callender's Ordinary shares.

Western Telegraph Co.—The directors have declared an interim dividend, payable on June 23rd, of 3s. per share (at the rate of 6 per cent. per annum), free of income-tax, for the quarter ended March 31st, 1906. The transfer books will be closed from June 16th to June 22nd.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations May 23rd.	Closing Quotations May 30th.	Business done week ended May 30th, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¼ — 4	3 — 3½	70/-	61/3	— ½
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	88 — 88	88 — 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2½%	3½%	67 — 69	67 — 69	..	..	..
9,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	6 %	114 —115	114½—115½	115½	114½	+ ½
9,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½%	26⅛— 26⅜	27⅛— 27⅜	27⅜	26½	+1
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅞— 8⅛	7⅞— 8⅛	..	..	..
1,932,856£	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96⅛— 98½	97 — 99	98	97½	+ ½
16,000	Cuba Telegraph	10	6½%	10 %	5 %	5 %	8½— 9	8⅝— 9	8½	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8½— 9	8½— 9	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103%	100 —103 %	..	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	3½%	15⅞— 16¼	15⅞— 16¼	16¼	15⅞	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	142 —145	142 —145	144½	144	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	89 — 91	90 — 92	91½	90	+1
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	106 —108	107 —109	107½	107	+1
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	7 %	14 — 14½	13⅞— 14¼	14½	14⅛	— ½
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½—107½	105½—107½	106⅜	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	100½	100	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5½%	11½— 11⅝	11½— 11⅝	11⅝	11½	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 15	14⅜— 15	15	14⅜	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	39 — 41	39 — 41	40⅞	40¾	..
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	57 — 59	57 — 59	58	57⅞	..
251,127	Marconi's Wireless Telegraph	½	Nil	Nil	Nil	Nil	1⅛— 1⅜	1⅛— 1⅜	22/6	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞— 1	⅞— 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	110 —112	110 —112	111⅛	110	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	108 —110	108 —110	109	108	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	13	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	11⅛	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5¼— 5⅜	5¼— 5⅜	5⅜	..	..
1,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	99½	98⅝	..
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	104 —106	103 —105	105¼	104	—1
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1⅜— 1¼xd	1⅜— 1¼	28/6	27/9	..
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1¼— 1⅜xd	1¼— 1⅜	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	99 —101	99 —101	100¼	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	100 —103	100 —103	101½	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %	7½— 7⅝	7½— 7⅝	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 —106	103 —106	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7½	7 — 7½	7⅜	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5⅝	5⅝	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —113	110½	..	+ ½
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜— 10⅛	9⅜— 10⅛	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —103	101 —104	..	..	+1
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14 — 14½	14 — 14½	14⅜	14¼	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..
563,380	Do. do. 4 % Debs. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	103 —106	105½	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	7/16— 9/16	7/16— 9/16	..	..	..
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	7⅛— 8⅛	6⅞— 7⅞	7⅞	6¾	—1½
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	5½— 6½	5½— 6½	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

* Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	7 — 7⅛	7 — 7⅛	7⅛	7 1/16	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅞— 6⅛	5⅞— 6⅛	6 1/16	5 15/16	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143	140 —143	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
800,000	Babcock & Wilcox, 1 to 580,000	1	..	17 %	20 %	20 %	3⅞— 4	3⅞— 4	80/-	79/4½	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅝— 1⅞	1⅝— 1⅞	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	2⅛— 2⅜	2⅛— 2⅜	..	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	5½— 6½	5½— 6½	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5½— 5⅝xd	5½— 5⅞	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	3⅝— 4⅛xd	3⅝— 4⅛	..	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —104 xd	100 —104	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	115 —118	115 —118	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	109 —112	109 —112	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —104	102 —104	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	104	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	6⅜— 7⅛	6⅞— 7½	7⅜	6 15/16	+ ⅛
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	9⅛— 9⅜	9⅛— 10	9 15/16	9 13/16	+ ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	114 —117	114 —117	116⅝	115	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	93 — 95	93 — 95	..	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¼— 6⅜	6¼— 6⅜	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5¾— 6⅛	5¾— 6⅛	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
100,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞— 2⅛	1⅞— 2¼	40/9	35/7½	— ⅛
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	9/16— 11/16	9/16— 11/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	⅜— ⅞	⅜— ⅞	16/3	..	..
150,000	Do. Non-cum. 6 % Pref... ..	2	6 %	6 %	6 %	6 %	1⅞— 2	1⅞— 2	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	97½	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	84 — 86	84 — 86	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅛— 3⅜	3⅛— 3⅜	68/9	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅝— 5¾	5⅝— 5¾	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	103 —105	103 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	9⅛— 9⅜	9⅛— 9⅜	9 1/16	9⅛	..
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8⅞— 9	8⅞— 9	..	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	106 —108	106 —108	..	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	11 — 12	10¾— 11½	11⅜	11	— ½
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅞— 6	5⅞— 6	5⅞	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108½—110½	108½—110½	110⅜	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅜— ⅝	⅜— ⅝	12/6	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 1/16— 1 3/16	1 1/16— 1 1/16	23/9½	23/-	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	99	..	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	88 — 90	88 — 90	89⅛	89	..
530,316	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	100⅛	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	77 — 80	77 — 80	79	..	..
1,480,000	City and South London Railway	Stock	3½%	2¾%	2½%	1½%	39 — 41	40 — 42	40⅝	40	+1
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	2 — 2½	2 — 2½	..	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations May 23rd.	Closing Quotations May 30th.	Business done week ended May 30th, 1906. Highest	Lowest.	Rise + or Fall−
		†									
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	..	1⅞ — 1⅞	1⅞ — 1⅞	36/3	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	104 —107	104 —107	107	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	6 %	13⅜— 14⅜	13⅜— 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅜— 15⅜	14⅜— 15⅜	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½—100½	99½—100½	..	..	..
300,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
300,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½%	..	1⅛— 1⅜	1⅛— 1⅜	..	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½%	..	2⅛— 3	2⅛— 3	..	..	..
844,023‡	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅛— ¾	⅛— ¾	10/3	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	2 — 2½	2 — 2½	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9⅛ — 10	9⅛ — 10	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3⅛— 4	3⅛— 4⅛	..	..	+ ⅛
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½— 11½	10½— 11½	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	100 —101	100 —102	..	..	+ ½
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13	..	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛— 5⅜	5⅛— 5⅜	..	..	..
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	109 —111	109 —111	..	..	..
108,022	Do. do. Scrip. 50 % paid	..	..	..	..	..	57⅛— 59⅛	57⅛— 59⅛	58⅛	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17/16	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	1½%	Nil	1⅜— 1⅝	1⅜— 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6 — 6½	6 — 6½	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	7 — 9	8 — 9	..	..	+ ½
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	3 %	2 — 3	1 — 3	..	..	— ½
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8¼— 9¼	8⅜— 9⅜	9	8⅜	+ ⅛
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	96 — 99	98	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	⅛— ¼	⅛— ¼	3/-	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛— 1	⅛— 1	19/6	19/-	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	102 —104	102 —104	102⅛	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	5 — 5⅛	4⅛— 5⅛	..	..	— ⅛
24,500	Potteries E. Tr., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	7⅛— 8⅛	7 — 8	..	..	— ⅛
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	8 — 9	8 — 9	8⅛	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32 — 34	32 — 34	33	32½	..
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	96 — 98	96 — 98	96⅜	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	99 — 102	99 —102	101	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3⅓%	3 %	Nil	Nil	1⅛— 1⅜	1⅛— 1⅜	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2⅛— 3⅛	2⅛— 3⅛	55/-	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 ⅝%	5⅛— 5⅝	5⅛— 5⅝	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8¾— 9¼	8¾— 9¼	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8¾— 9¼	8¾— 9¼	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	87/6	85/-	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜— 4⅞	4⅜— 4⅞	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅜— 4⅛	3⅜— 4⅛	75/-	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	3⅜— 4⅛	3⅜— 4⅛	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	102⅜	101⅛	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5½— 5⅝	5⅝— 5⅝	5/1	5⅛	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10¾— 11¼	10¾— 11¼	11/16	10⅞	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12¼— 13¼	12¼— 13⅛	..	..	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	128 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	102¼	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2⅛— 3⅜	2⅛— 3⅜	..	..	..
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 9	8 — 9	11¼	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11⅛— 12⅛	11⅛— 12⅛	..	..	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	100 —102	101 —103	101¼	101	+1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5 ⅝%	3⅜— 4⅛	3⅜— 4⅛	80/-	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4⅛— 5¼	4⅛— 5⅛xd	96/3	..	..
820,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	103 —106	103 —106	104	102½	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅛— 5⅝	5⅛— 5⅝	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8¼— 8⅝	8¼— 8⅝	..	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	7 — 8	7⅛— 8⅛	..	..	+ ⅛
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12%	12 %	10 %	10 — 11	10 — 11	..	..	..
90,000	Do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	100 —101	102	..	+1
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2 — 2⅛	2 — 2⅛	43/16	..	..
60,000	Do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅛	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	99⅛	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8¼— 9¼	8⅛— 9⅛	8⅝	..	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅝— 5⅞	5⅝— 5⅞	5/16	..	..
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7¼— 7⅜	7¼— 7⅜	..	..	..
75,000	Do. 5 % Pref.,1 to 75,000	5	..	5%	5 %	5 %	6 — 6⅛	6 — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7⅛%	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6⅞— 7	6⅞— 7	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅛%	14⅛%	14⅛%	12½%	10⅛— 11⅛	10⅛— 11⅛	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	7	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2¼— 2⅜	2¼— 2⅜	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	3 — 3½	3 — 3½	..	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	⅜— ½	⅜— ½	..	..	..
85,368	*(Late Blackheath and Greenwich* (7 % Pref.	1	Nil	7 %	7 %	7 %	1¼— 1⅜	1¼— 1⅜	..	..	..
148,292	*Dist. E.L.Co.)* (4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4 — 4½	3⅞— 4⅛	..	..	— ⅛
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4½— 5	4½— 5	95/-	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	101 —103	101 —103	101½	100½	..
110,000	Westminster Electric Supply, Ord.	5	12 %	18½%	14 %	13 %	10 — 11	10 — 11	10 15/16	..	..
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	5	5 %	5 %	5 %	5 %	5 1/16— 5 1/8	5 1/16— 5 1/8	5 1/16	5 1/16	..

Shares not officially quoted :—Mackay Companies, ord., 75— 76. Pref. 76—77.
† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

(Bank rate of discount 4 per cent. (May 3rd, 1906).

TANTALUM LAMPS.

BY PERCY GOOD.

HAVING purchased three tantalum lamps for use on an alternating-current circuit, and being immediately informed that they were not suitable, it was decided to burn them on a direct-current circuit, and measure the candle-power at intervals. Whilst quite understanding that three lamps are not sufficient for a test, the results may be of interest.

The lamps were supplied for a 110-volt circuit, but the average pressure during the test was 109 volts, and the maximum 110 volts. The measurements of candle-power and watts were made at exactly 110 volts. The following table shows the mean horizontal candle-power, and the watts per mean horizontal candle :—

—	Lamp No. 1.		Lamp No. 2.		Lamp No. 3.	
Hours.	M.H. Cp.	Watts per candle.	M.H. Cp.	Watts per candle.	M.H. Cp.	Watts per candle.
0	24·0	1·6	21·2	1·9	20·5	2·1
100	24·0	1·6	12·5	3·0	20·5	2·1
300	23·4	1·6	9·5	4·1	20·0	2·2
500	21·2	1·8	8·1	4·6	19·1	2·2
800	17·5	2·2	7·0	5·0	17·8	2·3
	Test stopped		Test stopped		Test stopped	

Lamp No. 2 blackened very considerably during the first 100 hours. The other lamps had blackened somewhat by the end of the test.

The ratio between the vertical candle-power and mean horizontal candle-power in the case of ordinary carbon filament lamps is about 0·7, but is by no means a constant. The values for these three lamps were 0·22, 0·25 and 0·20 respectively. The ratio increases during the life of the lamps owing to the portion of the bulb near the filament getting much blacker than the other parts. The figures are the average during the test.

The curves (fig. 1) show the distribution of the light in a vertical plane. The dotted curve is that of an ordinary carbon filament glow lamp taking the same number of watts as the tantalum lamps. The curve is based on lamps Nos. 1 and 3. Only half the curve has been drawn ; the other half

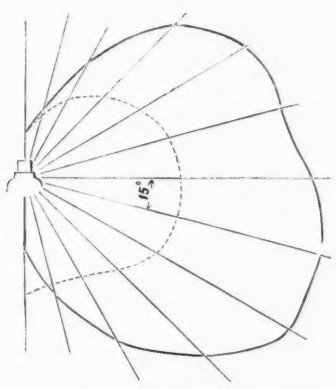

FIG. 1.—LIGHT DISTRIBUTION CURVE OF TANTALUM LAMP.

is practically the same. The increase in candle-power a little below the horizontal is due to the reflection from the curved portion of the glass at the top of the bulb. The following particulars, which may not be generally known, may be of interest :—

Tantalum is obtained from the mineral called tantalite, which has a composition somewhat as follows :—

Tantalum oxide (Ta_2O_5) 65 per cent.—68 per cent.
Niobium oxide (Nb_2O_5) 5 per cent.—7 per cent.
Manganese oxide (MnO) 7 per cent.

The mineral is insoluble in all acids. When used with potassium carbonate K_2CO_3 in a platinum crucible, the fused mass dissolves in cold water and the oxides of tantalum and niobium can be precipitated from the solution by hydrochloric acid, which redissolves the precipitate if added to excess. The metal can be reduced from the oxide at a temperature of 2,300° C., but the oxygen must be removed as it is formed, the reduction being carried out in an almost perfect vacuum. The metal is nearly as hard as diamond, but can be hammered or drawn into wire when cold. If heated to about 300° C. in air, it burns back to the oxide glowing like magnesium. Tantalum is not acted on by nitro-hydrochloric acid.

The deposit on the inside of the bulb is not acted on by this acid, and will not burn off, and is probably a deposit of the metal, or of niobium, small quantities of which may be in the filament.

The tests were carried out at Faraday House, and I am indebted to the Testing Institution for permission to publish the results.

PROCEEDINGS OF INSTITUTIONS.

The Faraday Society.

THE ELECTROLYSIS OF FUSED ZINC CHLORIDE.

THE problem of electrolysing fused salts, although as old as 1807, the date of Davy's classic experiments on the isolation of the alkali metals, has only of late years—since the establishment of the aluminium industry—again become an object of serious consideration at the hands of industrial chemists, although its importance and possibilities have never been lost sight of by great investigators, such as Bunsen, who, in conjunction with Matthiessen as early as the middle of last century, laid down the correct conditions under which alone these processes can be made possible of practical application. Apart from the case of aluminium, however, the only extraction of this kind that has attained the dignity of an industry is that of sodium, although calcium is now made, and is obtainable in such quantities as the very limited demand for it requires. The long array of failures of the older metallurgy to provide a really adequate solution of the favourite complex sulphide problem, has been the cause of the attention that has been paid during the past few years to the electrolysis of fused zinc chloride, and it is by no means beyond the bounds of probability that such a method of making zinc, if it were completely satisfactory from all points of view, would provide the key to the final solution of the larger and more baffling problem. One such attempt at the commercial electrolysis of zinc chloride is to be found in the latter stages of the well-known Swinburne-Ashcroft chlorine process, and now Mr. Julius Vogel, who read a paper on the subject before the Faraday Society on the 15th ult., tells us the interesting story of the experiments made by him and Dr. Steinhart (afterwards in conjunction with the United Alkali Co.) between 1898 and 1901, which had for their object the same end in view, but which differed from the Swinburne-Ashcroft method in that, whereas Steinhart and Vogel heated their electrolysing cells externally, in the Swinburne-Ashcroft process the heating is internal, being maintained by the action of the current itself.

The commercial success of the zinc chloride electrolysis ultimately resolves itself into the satisfactory surmounting of three distinct technical difficulties that are inherent in this particular electrolysis: First, the loss of efficiency occasioned by the formation of "zinc cloud"—that is, the liberated metallic zinc diffused through the body of the electrolyte in the form of finely-divided particles, and which recombines with the chlorine evolved at the anode; second, the troublesome but essential preliminary dehydration of the fused chloride; third, the very prosaic, but none the less fundamental, difficulty of finding a cheap and lasting material from which to make the cells in which the electrolysis is to take place. The formation of "zinc cloud" was fully investigated by Prof. Lorenz, of Zurich, many years ago, and he showed that it could be avoided by using a fused metallic cathode—usually, of course, zinc itself—and by paying careful attention to the temperature conditions.

For the dehydration of the zinc chloride many suggestions have been made. Dr. Lorenz evaporates with hydrochloric acid, an expensive and troublesome operation. An ingenious suggestion is that of Maxwell Lyte, who in 1897 proposed to subject the electrolyte to a preliminary reversed electrolysis, and split up the last traces of water into hydrogen, which is evolved, and oxygen, which forms zinc oxide with the anode, and so goes into solution in the fused chloride. Practical difficulties regarding consumption of current and discontinuity of action present themselves, however, in the application of this method to practice, and Mr. Vogel and Dr. Steinhart therefore, after much experiment, dehydrated their chloride by evaporating under reduced pressure, which afterwards became a good vacuum of 26 to 27 in., a method which they found to give complete satisfaction.

The problem of finding a suitable material for the electrolysis, was solved by Swinburne and Ashcroft in a characteristic fashion. They use iron cases lined with firebrick; the chloride soaks into the porous brick and solidifies, so it becomes a vat with zinc chloride walls! The author of the present paper states that the proper material for the construction of a cell is a vitreous stoneware, capable of standing a temperature of 500° C., which material

is obtainable, and that the cells should be constructed with the least possible number of joints. The dehydrating plant Mr. Vogel constructed of enamelled iron, a material that was subjected to some criticism by Dr. G. Rudorf, whose experience has led him to doubt its utility in the present connection.

The early experiments described by Mr. Vogel, which as an interesting record of instructive failures in face of great difficulties, should be carefully studied in the original paper, were carried out on a small scale in London. Ultimately the work was transferred to the laboratory of the United Alkali Co., at Widnes, where there was available a current of 600 amperes at 60-70 volts, and where complete plant was erected for the solution of the raw material—zinc oxide—in hydrochloric acid, for the purification, concentration, and dehydration of the chloride solution, and for the electrolysis itself. As regards the electrolysing vats, two types were installed. The first consisted of a shallow cell with the upper edge set back and turned up to form a seating for the carbons. In this cell the carbons themselves formed the cover. The carbons were constructed with the top 1½ in. thicker and longer than the lower part, in such a way as to leave room for the gas to escape. These carbons were fitted closely together and carefully cemented. The bottom edges were arranged exactly level with the bottom of the cell. Connection for the current was made by copper rods which dipped into pockets in the tops of the carbons, the pockets being filled with solder. The cathode connection was a heavy block of carbon placed at one end of the cell.

The alternative cell was constructed with a trough round the upper edges filled with melted solder to form a lute for a cover, the edges of which dipped into the trough. The carbons in this case were suspended by the ends which rested on either side of the cell. The extreme ends of the carbons dipped in the solder lute, which formed the connection to the positive lead. A species of well connected by narrow slots at the bottom to the cell, provided means for making the negative connection, and the removal of the zinc as it accumulated was to be effected from these wells by ladling. The cover, which was securely tied together by iron bands, was provided with feed holes, gas exit holes, &c.

The first type of cell gave the better results, and, after some modification, was finally adopted. This cell was run continuously for 10½ days and nights, at about 600 amperes and 4-5 volts, and produced over 3 cwt. of zinc at a current efficiency of 91½ per cent. The trial run convinced the author that an externally heated cell is preferable to one heated internally, and that a gas-heated furnace, fired uniformly at the correct minimum temperature at which no zinc chloride volatilises, will yield a high current efficiency, and generally, by not being troubled with the local heating obtaining in an internally heated cell—a view, by the way, directly controverted by Mr. W. Murray Morrison—can be worked more economically than the latter type. The economy, in Mr. Vogel's opinion, is enhanced by the fact that whereas in a well-constructed externally-heated cell the voltage could be reduced to three, at least six are required where the current is the heating agent, and that the energy represented by this extra voltage can be supplied more cheaply by direct producer gas firing than by current produced under ordinary conditions.

It unfortunately happened that just at this, the most interesting and promising stage of the experiments, the failure of the Smelting Corporation necessitated the suspension of the work, and finally all hope of bringing it to a successful commercial conclusion had to be abandoned. For the present then, until the advent of some benevolent and far-sighted capitalist, the problem still awaits ultimate solution.

PLATINISED ELECTRODES.

Mr. H. D. Law, in this paper, gives a short account of a curious reaction taking place on freshly prepared platinised cathodes. Contrary to expectation, the electrolytic reduction of benzaldehyde takes place far more rapidly on these than even on lead or mercury cathodes, although the potential of the liberated hydrogen is considerably lower. The product is, however, entirely different, and was not identified. The activity of the reduction diminished in successive experiments, and was extremely small after 12 hours' polarisation. The cause of the reaction, which is still under investigation, is obscure; it is probably catalytic in its origin.

Institution of Electrical Engineers.

THE report of the Council, presented at the annual general meeting of May 24th, 1906, shows that since the last annual general meeting 505 proposals for election have been considered, and there have been elected 10 Members, 159 Associate Members, 13 Associates, and 251 Students, 433 in all. The change in the roll during the last 12 months is shown in the accompanying table:—

	1905.	1906.
Honorary Members	6	6
Members	994	1,024
Associate Members	1,610	1,820
Associates	1,609	1,509
Students	1,321	1,487
Foreign Members	131	127
Total	5,671	5,973

During the past year there have been 18 committees at work; 15 general meetings, 19 Council meetings, and 110 committee meetings have been held.

The First Students' Premium, value £10, was awarded to Mr. A. G. Ellis, for his paper "Steam Turbine Dynamos"; the Second, value £8, to Mr. H. W. Taylor, for his paper "Some Notes on Single-Phase Railways"; the Third, value £5, to Messrs. F. C. Prentice and J. S. Westerdale, for their paper "The Efficiency of Lamp Globes"; and an Extra Premium, value £5, to Mr. W. Browning, for his paper "Notes on Electrical Conductivity."

In addition to the routine work of the session, the important work of revising the wiring rules of the Institution has been almost completed by the Committee appointed for that purpose, and it is hoped to publish the new edition before the end of the current year.

The Council directed its attention to the terms of the London Building Acts Amendment Bill, 1905, and, in consideration of the probability that the restrictions in the Bill would prejudicially affect buildings of electrical companies and undertakings, a petition against the Bill was drawn up and presented to Parliament.

The Workmen's Compensation Bill, 1906, also received attention. It was thought that the terms of the Bill were detrimental to the interests of certain branches of the electrical industry, and accordingly a letter was addressed to the Home Secretary petitioning that the objectionable clause might be altered.

In pursuance of a resolution passed by the Chamber of Delegates at the Electrical Congress at St. Louis, steps have been taken to secure the co-operation of the technical societies of the world by the appointment of a representative commission to consider the question of the standardising of the nomenclature and ratings of electrical apparatus and machinery. An Executive Committee has been formed by the council, with instructions to consider and report upon a scheme for the constitution of such an international commission, and a draft scheme has now been submitted for approval to the leading electrical associations of all countries. The first meeting of delegates of these associations will be convened at an early date.

The annual statement of accounts for 1905 shows that the financial position is again satisfactory. The income and expenditure compare with 1904 as follows:—

	Income.	Expenditure.	Carried to general fund.
1904 ...	£10,075 17 4	£7,950 1 5	£2,125 15 11
1905 ...	£10,369 0 8	£7,066 5 6	£3,302 15 2

The entrance fees for the year, which are not treated as income, amounted to £569 3s., and this sum has been carried to capital account.

Physical Society.

AT the meeting held May 11th, 1906, Dr. C. CHREE, F.R.S., vice-president, in the chair, a paper on "The Dead Points of a Galvanometer Needle for Transient Currents" was read by Mr. A. RUSSELL. When many types of needle galvanometer are connected with a condenser and a battery in the ordinary manner by a charge and discharge key, the following phenomena can easily be observed. When the needle is initially at right angles to the axis of the galvanometer-coil, and the spot of light is in the centre, x, of the scale, the throws on charge and discharge are equal. If the controlling magnet be turned through a small angle, or if the suspending fibre be twisted slightly so that the spot of light is not in the centre of the scale initially, the throws on charge and discharge are not equal. The algebraic difference between them, however, is constant. Hence, for an initial position p_1 of the spot of light there is no throw on charge, and similarly for another initial position p_2 there is no throw on discharge. These points the author calls the dead points. If the resistances of the charging and discharging circuits are the same, $x\,p_1 = x\,p_2$. In this case the distance $p_1 p_2$ varies directly as the resistance of the charging circuit, and inversely as the applied voltage. If the initial position of the spot of light be outside of $p_1 p_2$, the throws on charge and discharge are in the same direction. The author shows that these effects can be explained with considerable accuracy by supposing that the magnetism of the needle consists of two parts, one permanent and the other proportional to the magnetising force. As far back as 1868 Lord Rayleigh showed that this supposition is sufficient to explain the permanent deflexion produced by an alternating current passing through the galvanometer coil. In a paper also, in 1883, he pointed out that a galvanometer is a very imperfect instrument for indicating whether the integral sum of the transient currents through it is zero or not, and he also mentioned the limitations this imposes on Maxwell's method of comparing mutual inductances. The author finds that it is easy to arrange with a low-resistance galvanometer so that a, relatively speaking, gigantic charge can be passed through the coil without producing any throw at all. He also finds that all the galvanometers he has tested, whether needle or moving coil, will produce throws when certain transient currents pass through them, even although the integral value of these currents is zero. It also appears that the effective internal resistance of ordinary condensers is appreciable in certain cases. These results are of importance in connection with several of the customary methods of testing.

Mr. W. DUDDELL suggested that since the R term included all the I^2R losses, part of it might arise from eddy-currents in the condenser.

Prof. H. A. WILSON pointed out that if there was dielectric hysteresis there must be a loss of energy, which no doubt amounted to a resistance as determined by the author.

Mr. ROLLO APPLEYARD asked if it was necessary to assume that R was a resistance. It might be a physical constant of the condenser of another kind.

Mr. A. CAMPBELL said that the effects mentioned by Mr. Russell often gave trouble in actual testing work. Some years ago he found that in testing standard air condensers by Maxwell's method, an

ordinary needle galvanometer gave erroneous results unless its needle was exactly in the symmetrical position. A moving-coil galvanometer, however, gave satisfactory results.

The Author, in his reply, stated that dielectric hysteresis had probably some connection with the internal resistance of the condenser, but the effect was small. The energy radiated into space was also small. Mr. Duddell's suggestion of eddy currents might clear up any lack of uniformity in results obtained with very rapid oscillatory discharges. The author also showed how the resistance of a condenser could be measured in a minute or two by his method. The resistance of the actual condenser used in the experiments was found to be about 9 ohms.

Prof. H. A. Wilson exhibited a Lippmann capillary dynamo and electromotor from the George the Third Museum of King's College.

Mr. W. Duddell exhibited some mechanical and electrical phenomena occurring in the telephonic transmission of speech. The apparatus is intended to demonstrate by curves on a screen the simultaneous movement of the microphone transmitter diaphragm, the current flowing into the telephone line, the current received at the far end of the line, and the movement of the receiver diaphragm when sounds or speech are being transmitted. The similarity of and the difference between these four curves can be examined by the aid of the apparatus, and the distortion and attenuation produced by the resistance, capacity and self-induction of the line can be demonstrated, as well as the distortions produced by the diaphragms of transmitter and receiver. The characteristic shapes of the curves corresponding to the different vowel sounds and their dependence on the pitch at which they are sung can also be exhibited.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Consumed" writes:—"A Municipal Corporation supplying electricity under Act of Parliament, makes the following arrangement in supplying buildings used for offices, and containing a large number of different tenants or sub-tenants, viz:—A meter is supplied by them to each tenant or sub-tenant, and readings are taken off these meters quarterly in the usual way. But, in addition, a master meter is erected, and the owner of the premises, or the principal tenant, as the case may be, is charged with the amount of energy registered by this master meter, being at the same time furnished with a record of the readings of the sub-meters, so that he may charge his tenants with the corresponding amount.

"Now, in this special case, the readings of the master meter exceed by an amount equal to about 15 per cent. the readings of the sub-meters, and this amount the owner of the premises is unable to recover from his tenants. The object of this arrangement on the part of the Corporation is, that they may protect themselves against bad debts.

"The difference in readings of the master meter and the sum of the readings of the sub-meters, which are not, and cannot be, switched off every night, is due to the fact that the shunts of the sub-meters are in circuit day and night, and the work done by them is, of course, recorded by the master meters.

"Would you be good enough to let us know whether it is legal for supply authorities to charge for the energy necessary for the shunts of their meters in this way?

"We may say that we believe the meters register correctly within ordinary limits, and the Corporation claim that the loss is in the mains. This claim is, of course, absurd, as no consumer would put up with the 15 per cent. drop of pressure, but we have ascertained that the drop of pressure on the full load is inappreciable, and that the insulation of the mains is good."

*** This is an extraordinarily interesting point, and is not, so far as is known, covered by authority. While it is difficult to answer the question without access to the contract between the owner of the premises and the Corporation, it is reasonably clear that in no case where electricity consumed is measured by meter, does the supply company charge for that which passes through the meter shunt. This for the very good reason that the amount which so passes is not generally recorded.

Assuming that the contract between the owner and the Corporation provides that the owner shall pay for the electricity "consumed" by the sub-tenants, it would be a question for the Court to say whether the electricity passing the shunt is so consumed. It is submitted, however, that no Court would hold that to be "consumed" which is not recorded on the consumer's meter; and this being so, the owner would be entitled to a rebate of 15 per cent. But assuming that the contract provides that the owner shall pay in accordance with the readings of the master meter, it would seem that the fact that some of that electricity has gone to waste does not affect the question, and the owner would be liable for the full amount.

If "Consumed" would forward a copy of the contract between the owner and the Corporation, it would be possible to give a more definite opinion.

"Assistant" writes:—"Given a company working under the Acts of 1882 and 1888, with several consumers on its mains who have change-over switches in use as a standby, in case their own private supply at 100 volts fails; and that the company, whose declared pressure just now is 100, intends changing over to 230 volts, it would be interesting to know whether the company is bound to continue giving a supply to these consumers at 100 volts."

*** The position of a consumer who uses the supply from the company's mains as a "stand-by" is no better and no worse than that of an ordinary consumer. What, then, are the conditions under which a company is entitled to change the pressure at a consumer's terminals? By Sec. 6 of the regulations under the Electric Lighting Acts, 1882 and 1888, undertakers must, before commencing to give a supply of energy, declare to such consumer the constant pressure at which they propose to supply energy at his terminals. Such pressure could not formerly be changed, except with the consent of the consumer, subject to an appeal to the Board of Trade. Under this rule it was found that any consumer, or a small minority of consumers, might prevent a change of pressure altogether. Now, however, by an additional regulation made in 1901, where the consumer withholds his consent after the undertakers have offered to comply with the general terms and conditions imposed by the local authority, and if not required to do so under those terms and conditions, also to pay the reasonable cost of, or incidental to, the change (including compensation for any loss or damage incurred in consequence of the change), the undertakers may appeal to the Board, who may, if they think fit, give their consent to the change on such terms and conditions as they impose, and the consent of the Board so given shall, for the purpose of this regulation, have the same effect as the consent of the consumer.

PARLIAMENTARY.

North-West London Railway.

(*Concluded from page* 860.)

On 22nd ult. the Committee heard the case for the Lessees of the Grosvenor Estate. Mr. Acworth contended that the scheme ought not to be allowed to proceed until some Traffic Board, yet to be constituted, had decided how the arrangements for the interchange of traffic were to be made. The promoters could get their exchange stations only upon such terms as the other companies would accept. As to the question of finance, practically all the tubes, with the exception of the Central London, were financial failures, and it was undesirable that another should be added to their number to scare the public from investing.

The Chairman of the Committee remarked that learned counsel had not dealt with the possible damage to his clients as frontagers.

Mr. Acworth replied that he had been instructed to deal with the matter when clauses were considered.

Mr. Moon, K.C., then addressed the Committee for the promoters. Even if a tramway from Cricklewood to the Marble Arch were constructed, the route was of such importance that a tube would still be necessary, and it had to be remembered that the London County Council would not get its Bill if the local authorities exercised the veto.

The Chairman: That does not refer to a shallow subway?

Mr. Moon: Along the Edgware Road? I do not know what the local authorities would say to that.

Coming to the financial aspects of the scheme, Mr. Moon said that there could be no doubt that there were sound commercial probabilities in it. If it was a scheme of public utility it could not avoid being sound. The district was very rich in traffic.

The Chairman: The Committee have to decide not only whether the scheme is of public utility, but whether there is a probability of the ordinary investor putting his money into it, so that the scheme may not be on paper for a few years blocking the way of any other scheme.

Mr. Moon remarked that, if there was any possibility of the scheme being a blocking scheme, it would only show that there was a real necessity for it. The Baker Street and Waterloo and other tubes were incomplete, and it was unfair to say that they had not come up to expectations. This present scheme was, with the exception of the Central London, the best tube scheme which had been promoted. It was proposed to have zonal fares so that they might carry many passengers at 1d. which the Central London, with its 2d. fare, did not carry. He did not suggest that the line would be a luggage-carrying line. Passengers going on to the Brighton line would send their luggage on, and many of them would be those going on day trips.

The Chairman: Taking a bag of nuts and an orange.

Mr. Moon: And coming back with a bit of seaweed. In conclusion, Mr. Moon dealt with the exchange stations.

The room having been cleared, the Committee deliberated in private, and on the re-admission of parties, the Chairman announced that the Committee found the preamble of the Bill proved. The Committee imposed four years as the extension of time for the completion of the line, and two years as the period for the acquisition of land. They expressed the opinion that an attempt should be made to come to an arrangement with the Metropolitan Co. as to an exchange station at Edgware Road. The Marble Arch station should also be so constructed that an exchange station could be made. Further, they desired that a clause embodying the agreement with the Brush Co. should be inserted.

Kent Electric Power Bill.

THIS Bill came before Lord Brougham and Vaux's Select Committee of the House of Lords on Monday, May 21st, when the case for the promoters was opened by Mr. C. C. HUTCHINSON. The Bill, he said, was promoted to increase the powers which the company already possessed for the supply and distribution of electrical energy within the county of Kent. The company was incorporated in 1902, with a capital of £750,000, with borrowing powers of a third of that amount. Energy was to be supplied under the Act of 1902 to (1) authorised undertakers, and (2) to persons requiring a supply for power. There was also the restriction that they were not to supply energy for lighting purposes except to distributors. Where any distributing company refused to give consent to the supply of energy in their area, the B. of T. were to be appealed to. Counsel dealt at some length with the agreement with the Kent Electric Power Syndicate, and said that the company had not rested on their oars. They had acquired the undertaking of the Chatham Co., which would shortly produce a revenue of £7,000 to £8,000 a year. Counsel then explained that by the present Bill the company sought to connect up with the South Metropolitan Co., to construct a pier, and carry out other works.

Mr. A. A. C. SWINTON, engineer to the promoters, bore out counsel's opening statements, and said that out of their capital of £750,000 the company had raised £220,000.

Mr. FREEMAN, K.C., addressing the Committee on behalf of the L.C.C., asked that the scheme should stand over until the L.C.C. Bulk Supply Bill, now under consideration, had been dealt with.

On Wednesday, May 23rd, the Committee found the preamble of the Bill proved, and it was allowed to proceed.

L.C.C. (Electric Supply) Bill.

(*Continued from page* 860.)

TUESDAY, MAY 22ND.

AT the commencement of the proceedings the CHAIRMAN intimated that the Committee wished the opposition of the promoters of the Administrative County of London Bill to be taken at this stage, and the

Hon. J. D. FITZGERALD, K.C., thereupon addressed the Committee on behalf of the promoters of that scheme. It was a matter for regret, he said, that the ordinary procedure had not been followed and all the competing Bills referred to the same Committee. By the terms of its reference, however, the Committee was entitled to hear the case of his clients against the L.C.C. Bill. The question to be considered was not whether the L.C.C. scheme would or would not pay; the question was whether it was the best scheme for dealing with the problem. No doubt the scheme might pay if they could get a sufficient number of authorised distributors to take such an amount of electrical energy at such a price as would pay the working expenses, and the interest and the sinking fund charges. That would make a paying concern, but it would not necessarily be an undertaking which would provide for the electrical requirements of London. There were three things which such a scheme must take in:—Supply to manufacturers, to tramways and railways, and the question of the bulk supply. The L.C.C. Bill was a bulk supply scheme tacked on to the tramway generating station, and was totally inadequate for a suburban railway supply. One of the main essentials of a successful power scheme was the entering into contracts for the hiring out of machinery for the purpose of assisting the manufacturer, and it had been calculated that if all the machinery of London were worked electrically it would mean a saving of £2,000,000 per annum to the manufacturers. Such an undertaking could not be undertaken by the L.C.C. They did not take any powers in their Bill to get at the manufacturers, although it had been suggested that Clause 35 would have that effect. But how could the L.C.C. with any grace at all put that clause into effect when they themselves were refusing to have a maximum price put into the Bill in regard to themselves, and, still further, refused to be compelled to supply anybody. No railway company or manufacturer had been called in support of the Bill, and it had been shown that by 1915 only 60,000 KW. would be available.

The CHAIRMAN remarked that the Committee realised that the L.C.C. scheme was only an instalment.

Mr. FITZGERALD said that he agreed; but while it was possible to build by instalments, it would be impossible to treat a transmission system in the same way, and the transmission system proposed by the L.C.C. would be capable of dealing with only 80,000 KW. The voltage to be adopted also had an important bearing on the scheme. Energy varied with the square of the voltage; and he had been informed that the extra cost of laying the necessary transmission system for 6,600 volts as compared with 20,000 would be £2,000,000. That expenditure would be incurred if the Council got the whole of the railway supply. Continuing, Mr. Fitzgerald dealt with the prices proposed to be charged, comparing them with those of Newcastle, where the price was lower than in London. Learned Counsel was going into details as to the three generating stations at Barking, Greenwich and West Ham, when the Chairman interposed, and asked that the question of whether the scheme was better than that of the L.C.C. should be dealt with. This, Mr. Fitzgerald said, he would confine himself to, and proceeded to deal with the broader issues involved. On the question of the purchase clause, he said that the period was 42 years at the value of the undertaking, without any allowance for goodwill. In concluding, he said that there had been a want of success in the case of the majority of electric power companies, and argued from this that such speculative concerns ought not to be undertaken by a municipality but should be left to private enterprise.

Mr. C. H. MERZ, the engineer to the promoters, was then called, and gave evidence as to the engineering and other details of the scheme.

WEDNESDAY, MAY 23RD.

Mr. MERZ, replying to the Chairman, said that the reason his company was better able to give a supply to the metropolis than the L.C.C. were, was that the company were in a better position to push business. Electricity could be far more cheaply supplied from the company's proposed stations than from those proposed in the L.C.C. scheme. A large station was of no use unless they got a good load for it.

Mr. NORMAN put it to witness that the suggestion had been made that the L.C.C. would have an advantage in possessing a tramway load.

WITNESS replied that the company would deprive the L.C.C. of that. They would find it cheaper to take their current from the company, and, in fact, it would be made a condition of the company's Bill that they should save the L.C.C. £20,000 a year on their tramways.

In reply to further questions, WITNESS said his scheme would tend to minimise the smoke nuisance.

Mr. FERRANTI, called on behalf of the promoters of the Administrative Bill, said in cross-examination that he had approved of Mr. Merz's scheme last year. It was true that that scheme proposed a station at Fulham, but he did not think that that station would ever be used.

Mr. CLODE asked witness if he had considered the question of the possible damage from smoke from that station?—WITNESS said that he had not considered the matter. He admitted that London was not comparable to any other place, and he did not know of any place relying on a ring main carrying 20,000 volts.

By the COMMITTEE: A pressure of 20,000 volts could quite safely be carried underground. A large quantity of 20,000-volt cable was now being made. He thought that if the L.C.C. had not had their tramways they would have gone in for a 12,000-volt scheme at least.

Mr. RUTHERFORD questioned witness as to the Battersea station of the L.C.C. Bill. Was there any danger of the smoke injuriously affecting London? WITNESS thought there would be; but added that all generating stations were bad, as they all burnt coal. He could not say that it was impossible to overcome the difficulty, because no one knew what the future might bring forth.

Mr. RUTHERFORD: You think some of the smoke might reach the House of Commons?

Mr. FERRANTI: It would, no doubt, reach all over London. I don't know that it would matter much if it reached here.

Mr. RUTHERFORD: Not if it poisoned all of us!

In reply to further questions, WITNESS said that if the L.C.C. were to have any part in the supply of electricity to London, they should have the unspeculative part. He thought the Administrative Co. would be willing to take up the speculative part, and he outlined a scheme by which London might be divided.

MONDAY, MAY 28TH.

Mr. HARPER addressed the Committee on behalf of the Middlesex County Council. He contended that the proposed generating stations were not so placed as to be suitable for the area, and a further objection was that the portion of Middlesex scheduled in the Bill was purely residential, and did not take in the industrial part. The supply to the tramways in Middlesex could be regarded as having gone, as it was contracted for until 1930. If London were to be treated as a whole, the needs of Middlesex should be dealt with jointly; but the Middlesex County Council were of opinion that municipal electric supply should either be dealt with as regards industrial counties, or by some combination of county councils. Under the present scheme, the L.C.C. might charge consumers outside the County of London at higher rates than those inside the county.

Mr. BANKS MARTIN was then called in support of the opposition of East Ham. He said that the electrical undertaking at that place had been a financial success, although it had only been working for three years.

Mr. WEDDERBURN, addressing the Committee on behalf of Woolwich, said that he was not opposing the L.C.C. becoming the bulk authority for London, but was opposing the very undesirable control which the Bill gave over the prices charged by the Borough Council. Just as Woolwich had at considerable expense got rid of all competition, the competition would be renewed by the L.C.C.

The Kent Electric Power Co.'s case was then opened by Mr. CAMPBELL SWINTON, joint engineer to the company, being called. The company, said witness, was authorised in the year 1902 to supply electrical energy in the county of Kent. They had raised £300,000, and had acquired land at Frindsbury, where plant up to 100,000 H.P. could be erected. The capacity of the plant already installed was 5,000 KW. Contracts for a supply at a cheaper price than that mentioned by the L.C.C. had been entered into by his company.

Mr. HUTCHINSON explained to the Committee that the company objected to be included in the area of the L.C.C. Bill, and it was thought that the "continuous area" clause should be included in the Bill.

Mr. PAYNE, chairman of the Law and Parliamentary Committee of the Westminster City Council, called as the first witness in support of the opposition of that Council, stated that, in his opinion, the merit of the Administrative Co.'s scheme over that of the L.C.C. was that the former could not possibly involve any charge upon the rates. The November conference was, he thought,

absolutely useless, because it had so few details before it to form an opinion upon.

At the sitting on Tuesday the Committee adjourned until June 12th.

(To be continued.)

London Outer Circle Railway.

(Continued from page 859.)

WEDNESDAY, MAY 23RD.

On Wednesday, May 23rd, Mr. MORGAN, formerly M.P. for the Walthamstow division, was called in support of the scheme, and said that it would be of great advantage to the working classes in the East-end, more especially by giving access to the docks, where many thousands were employed. He considered that the suggestion to terminate the railway at Walthamstow, by the Great Eastern line, would diminish the utility of the scheme. At first he thought the traffic would be mainly passenger traffic, but in course of time the advantages of sending goods direct from the docks to the various parts of London without having to go through the City would become apparent, and would lead to considerable trade. In reply to the Chairman, witness could not say anything as to the financial prospects of the scheme; he was not competent to give an opinion.

Mr. KIRBY, partner in a firm of dairy farmers at Elstree, also gave evidence.

Mr. VENABLES, of the late firm of Prichard, Venables & Co., surveyors and estate agents, said that, in his view, the scheme would be of great value in assisting the development. At the present time the cost of building material in the neighbourhood of Harrow on the Hill was high, because the means of access were limited. As an instance of the difficulty of getting from one place to another, witness mentioned that, wishing to get from Sudbury to Finchley, he had to take train from Wembley to Euston, walk to King's Cross, and then get a train for Finchley; the journey occupied two hours and three minutes.

Lord MONTAGU OF BEAULIEU, a director of the syndicate promoting the scheme, was called, and stated that he had subscribed to the preliminary expenses, his liability being £250. Having considered the question of north and south communication, he thought a large traffic might be expected. If the line were not an immediate success, there could be no doubt about its being so in a few years' time.

MONDAY, MAY 28TH.

On Monday, May 28th, Mr. P. DAWSON put in estimates as to the cost of providing the electric traction for the line on the single-phase, high-tension, overhead system. He said that the system proposed was similar to that which, upon his advice, had been adopted on the suburban lines of the London, Brighton and South Coast Railway. The estimated cost of the two generating stations on the land at Heston and Tottenham, including the machinery, was £300,000. Both places were easily reached for the purpose of a coal supply, and further than that water was available for purposes of condensing. For a double line and sidings on the overhead system the estimate was £303,000. Taking the rolling stock for composing 34 trains at £374,000, the total estimated cost was £977,000. In the case of the electrification of the line not being carried out the first two items would, of course, disappear. The trains proposed would be so constructed as to be able to work over the Metropolitan system. The single-phase high-tension method of working had been installed on the New York Central Railway. The equipment he had estimated for would be sufficient for goods traffic. Each train would have a capacity of 300 passengers, and there would be an average service of 10 minutes. The saving if steam were adopted would be about one-third of the estimated cost.

(To be continued.)

Lancashire Electric Power Bill.—The Select Committee of the House of Commons, presided over by Mr. Alfred Hutton, has passed the preamble of the Lancashire Electric Power Bill, which asks for further power with regard to supply within the areas of electric lighting authorities; to take transfers of electric lighting orders, &c. When the Bill was first promoted, a great deal of opposition was threatened, no fewer than 64 local authorities petitioning against the clause which allowed the company an appeal to the Board of Trade where the local authority refused to allow them to come in. It was stated that the promoters had now come to an agreement to only give a supply with the consent of the local authorities, and consequently the Bill was practically unopposed. Mr. Jeeves, on behalf of the St. Helens Corporation, asked that the promoters should insert a clause providing that in the event of the boundaries of the borough of St. Helens being extended, they should sell the mains and works within the extension to the Corporation. Mr. Ram, for the promoters, accepted the clause, providing that nothing in the Bill should prejudice an agreement being made with the Corporation.

Cork City Railways and Works Bill.—After a protracted hearing, the Select Committee of the House of Commons, presided over by Mr. Ashton, has found the preamble of the above Bill proved, the object being to incorporate a company with a capital of £150,000, to construct and work railways in Cork. Power is taken to work the railway by electricity, and to purchase electricity in bulk from the Cork Electric Tramways and Lighting Co.

Folkestone and District Electric Supply Bill.—This Bill came before the Unopposed Bills Committee of the House of Lords on Tuesday, May 22nd, Lord Onslow presiding. The measure was allowed to proceed, and will be reported in due course.

Electric Lighting Provisional Order (No. 7) Bill.—On Monday the Examiner found that Standing Orders had been complied with in the case of this Bill, which was ordered to proceed. The Bill confirms the following orders granted by the Board of Trade:—To the Rural District Council of Barton-upon-Irwell; to the North Metropolitan Electric Power Co., in respect of Cheshunt; to the Corporation of Dorchester; to the Slough and Datchet Electric Supply Co., in respect of the rural district of Eton; to the Hexham and District Electric Supply Co. for the extension of their existing district; to the Kidderminster and District Electric Light and Traction Co., in regard to Southport and Kettering; and to the Uxbridge and District Electric Supply Co. for an extension of their district.

Electric Lighting Provisional Order (No. 6) Bill.—This Bill, which confirms the Board of Trade Orders to the Strathclyde Electricity Supply Co. in respect of the districts of Eastwood and Cathcart and of Kilpatrick came before the Examiner on Monday. Standing Orders were found to have been complied with, and the Bill was ordered to go forward for second reading.

South Wales Power Distribution Co. Bill.—In the *London Gazette* for May 25th notice appears of application for additional provisions to be inserted in this Bill for the purpose of rearranging the capital and borrowing powers, the creation and issue of debenture stock, preference and ordinary shares and other matters.

Tramway Orders Confirmation Bill.—The Bill confirming Tramway Orders granted by the Board of Trade came before the Examiner on Thursday last week. The Orders relate to the following districts:—Order to the Urban District of Altrincham to construct the tramways authorised by the Altrincham U.D.C. Tramways Order, 1904; to the Dewsbury Corporation authorising an extension of time for powers granted in 1904; to the Newcastle-on-Tyne Corporation authorising three small junction lines; to the Ossett Corporation extending time for constructing authorised tramways; to the Musselburgh and District Electric Light and Traction Co. authorising the construction of a number of tramways in an extension of the Portobello and Musselburgh system; to the Rochdale Corporation authorising the construction of additional tramways in the borough. Mrs. H. Davie opposed the Portobello Order on the ground that she had not been served with proper notices, but the objection was overruled, and the Bill was ordered to proceed for second reading.

Second and Third Readings.—In the House of Lords on Monday, the West Yorkshire Tramways Bill was read a third time and passed.

In the House of Commons on Monday, the following Bill was read a second time:—Nottinghamshire and Derbyshire Tramways Bill.

The following Bills were read a third time:—County of Durham Electric Power Supply, Cumberland Electricity and Power Gas, Southport and Lytham Tramroad (Extension of Time), Newcastle-on-Tyne (Electric Supply). In the Commons the following Bills were considered and ordered for third reading:—Baker Street and Waterloo Railway, Lancashire Electric Power, and St. Pancras Electricity. On Tuesday the Metropolitan Railway Bill was read a third time, and the South Lancashire Tramways (Extension of Time) Bill was ordered for third reading.

Electric Power Supply for London.—Mr. Nield asks the President of the Board of Trade in Tuesday's Parliamentary Papers whether he will enlarge the terms of the order of reference on the London County Council (Bulk Electricity) Bill, now before a Select Committee, so as to admit evidence and report upon the question of the cheapest and best method of generating electricity in bulk so as to create a general demand for its use for lighting, heating, and power purposes, and also the practicability of establishing a central authority for large areas to deal with such supply on the lines of the Metropolitan Water Board. Mr. Lloyd-George replies as follows:—"The Committee have been considering the Bill for 12 days, and it is too late now for me to suggest any alteration of the terms of the reference, even if I thought that these terms were not sufficiently wide. I have no reason for thinking that the Committee would be precluded from considering the points mentioned by the honourable member."

Folkestone, Sandgate and Hythe Tramways Bill.—This Bill was exhaustively considered by a Select Committee of the House of Lords last week, and the preamble was proved.

Bath Tramways Extensions.—The Light Railway Commissioners have submitted the Bath Electric Tramways (Light Railways Extensions) Order, 1906, to the B. of T. for confirmation.

Aldershot and Farnborough Light Railway.—Application has been lodged with the Light Railway Commissioners by J. Browne-Martin and others for an order to construct, &c., this 3 ft. 6 in. gauge electric line.

Dudley and District Light Railways.—The Corporation is applying to the Commissioners for an Amendment Order relating to the borrowing of money, purchase of powers, &c.

Street Lighting by Electricity.—The YORKSHIRE ELECTRIC POWER CO., LTD., has just published a 20-page pamphlet on the subject of street lighting. The general question is discussed, the advantages of electricity are pointed out, the various improvements effected in forms of electric street lighting are noted, and a list of towns which have abandoned gas for electric lighting is given. Illustrations of a number of streets lighted electrically by arc, incandescent, Nernst and tantalum lamps, appear.

ELECTRICITY SUPPLY STATIONS OF SOUTH AFRICA.

LIGHTING SYSTEMS.

Compiled by E. POOLE, A.M.I.E.E., Durban, for the ELECTRICAL REVIEW.

(Copyright.)

Locality.	Date of opening.	Owners of works.	Engineer or manager.	System.	Station pressure.	L.T. distribution.	No. of consumers.	No. of 8-C.P. lamps.	Supply pressure.	No. and type of street lamps.	No. and H.P. of motors.	Plant capacity (KW.).	Boilers.	Engines.	Generators.	Units sold.	Price per unit.	Costs per unit.	Remarks.
Johannesburg ..	1892	Municipality	J. F. I. Thomas	Town.—H.T. alt. S.P. 60 ~ L.T. D.C. 3-wire 230 volts. Suburbs. — A.C. 3-phase 50 ~	2,000 A.C., 460-520 D.C.	Town. — Underg. D.C. Suburbs. — Overhead alt. 3-wire distribution	2,420	129,790	230 D.C. town, 200 A.C. suburbs (under new system)	62 arcs, 996 inc.	44 of 400 H.P.	About 1,000	12 tubular	15 Turner, W. & R. Allen	M. & P., E.C.C. and A.E.G.	3,397,521	1s. 2d. and 4d. light; 4d., 5d. and 6d. power (8·17d. aver. obtd.)	7·4d.	New plant to be eight gas-driven generators=13,000 H.P. Robinson Deep Gold Mine Co. and Brakpan assist in supply to town.
Kimberley ..	1903	De Beers mines	R. W. Smith	A.C. 3-phase 50 ~	5,000	3-phase, 120 & 240 v. underg. and overhd. mains	Mines; 1,000 private; & Beaconsfield	50,000	220	580 arcs	370 of 6,100 H.P.	3,500	12 B. & W.	3 Parsons, West. turb.	3 West. 3-ph. alt.	9,000,000	6d.	—	Supplying also for Alexandersfontein trams through rotary conv.
Brakpan	1897	Rand Cen. Elec. Wks.	H. Spengel	H.T. A.C. 3-phase 50 ~	12,000	H.T. dist. only. Bare overhead mains	27 (bulk) also Johannesburg	—	Various	—	86 of 2,482 H.P.	3,300	8 Steinmüller	4 Hartmann, 1 Wyss turb.	4 700-KW., 1 500-KW. S. & H.	10,000,000	6d. and 1d.		
Durban	1897	Municipality	J. Roberts	A.C. S.P. 62 ~ light 500 V. D.C. trams	2,500 A.C., 550 D.C.	Bare overhead 2 & 3-wire suburbs; underground 2-wire town	3,167	134,911 (Private lamps only)	100 & 200 v. ltg. 100 and 200 A.C.; 500 D.C. pr.	255 arcs, 1,240 incan.	100 D.C. of 1,049 H.P., 38 A.C. of 124 H.P.	3,150	2 Danks, 6 B. & W., 6 Hornsby	4 Yates & Thom, 5 Willans	3 E.C.C., 6 Dick Kerr	4,419,651 (including trams)	Light, 8d., less dis.; power, 2d. to 1d., plus st'nd'g ch'rge	3·89d. (total)	800-KW. Belliss-E.C.C. 2-phase alternator ordered. *Trams, 1½d.
Cape Town ..	1895	Municipality	W. F. Long	D.C. 3-wire	440	Underground town; overhead suburbs	1,332	95,300	220 and 440	44 arcs, 877 inc. 18 Nernst	2,140 H.P.	2,150	4 Davey-Paxman, 2 B & W.	1 Bumsted, 1 Belliss, 2 Ferranti	*1 M. & P., 1 Crompton, 2 Dick, Kerr, 2 S. & H.	1,860,000	10d. to 8d. (night) 5d. to 4d. (day); motors, 3d. flat	3·825d.	238 Tudor cells. *Two are driven by Pelton wheels.
Germiston ..	1898	General Electric Power Co.	A. W. K. Pierce	H.T. A.C. 3-phase, 60 ~	3,300	Bare overhead 3-phase 4-wire	493 Germiston town; 9 mining	13,000 (Germiston)	115 lt., 200 pr. (Germiston); 3,300 to mines	10 arcs, 34 inc.	23 of 245 H.P. (Germiston)	2,000	2 B. & W., 8 Stirling	3 Allis, 1 Curtis	3 Brown-Boveri, 1 G.E.C.	8,656,894	9d. light, 4d. power	—	1,750 KW. alt. and six boilers to be installed; chiefly supplying mines in bulk 24-hours' service.
Pietermaritzburg	1898	Municipality	A. S. Munro	H.T. A.C. 100 ~ light; 500 V. D.C. trams	2,050 A.C., 550 D.C.	Underground 2-wire, Brush transformers	1,068	34,692	200	116 arcs	46 A.C. and 3 D.C. of 300 H.P.	1,080 lt., 240 tr.	14 Hornsby	12 Willans	10 Mordey-Victoria A.C., 2 D.C.	985,277	9d. & 6d. light (max. demand) 2d. to 4d. power	3·855d. (total 7·38d.)	55 Tudor cells
Pretoria	1902	Municipality	T. C. Wolley Dod	D.C. 3-wire	550	Underground feeders, overhead dist.	1,300	50,000	250	80 arcs, 100 Nernst	35 of 400 H.P.	1,310	8 Marshall-Heine, 1 B. & W.	5 Chandler, 1 Belliss	3 E.C.C., 2 L.D. 1 A.E.G.	1,000,000	7d. to 1s. light, 2½d.* power		*Plus 5s. per month per H.P.
East London ..	1899	Municipality	J. M. Lambe	H.T. A.C. S.P. 50 ~ light, 500 V. D.C. trams	2,100 (lt). 550 (tr).	Bare overhead 2-wire	875	36,000	220 and 110	50 arcs	20 A.C., 110 H.P., 6 D.C., 50 H.P.	500 lt., 750 tr.	4 B. & W., 1 Paxman	9 Belliss	6 Fowler, 2 D.K.	432,000	9d. light, 6d. power	—	
Bloemfontein ..	1900	Municipality	*H. F. Peet, city eng.;	H.T. A.C. 3-phase 50 ~	2,000	Overhead and underground	388	19,291	200 and 110	15 arcs, 212 inc.	10 of 122 H.P.	500	4 B. & W.	3 Belliss	2 Crompton, 1 A.E.G.	278,250	1s. light, 4d. power	9½d. (total)	Destructor. *J. Grant, elec'n.
Buluwayo ..	1897	Buluwayo Waterworks Co.	F. L. Lister	A.C. S.P. 125 ~	2 080 to 2,300	House transformers	520	13,000	104	Series incan.	—	380	B & W., Fraser and Chalmers	Robey, Macintosh	1 E.C.C., 2 G.E.C.	—	2s. to 1s. 5d., sliding scale		
Delagoa Bay ..	1898	Cie. Gen. d'Elec.	J. Askew	D.C.	240	Overhead mains 3-wire	263	8,600	120	693 inc. 12 arcs	—	240	3 Elephant, 1 Galloway	3 Corliss (French)	6 A.E.G.	—	2s. 8d. to 1s. 6d. (light), 3½d. pub.	—	Extension plant ordered.
Harrismith ..	1904	Municipality War Office	W. B. Brady. J. E. Mandlen	H.T. A.C. S.P. 50 ~	2,000	3-wire underground.	150	3,800	200	2 arcs, 68 inc.	—	185	2 Climax	3 Howden	3 M. & P.	37,000 (6 months)	9d. to 1s.		
Middleburg ..	1904			D.C. 3-wire	500	3-wire underground.	Camp only (400 bdgs.)	3,000	250	65 Nernst	—	150	3 Ruston-Proctor	3 W. & R.	6 E.C.C.	—	—	2·5d.	Cantonments lighting only.
Kroonstad ..	1904	Municipality	Julian Vowles	D.C. 2-wire	230—240	Overhead 2-wire	140	5,500	230	20 Ner., 55 inc.	4 of 104 H.P.	120	2 Ruston-Proctor	2 W. & R.	2 E.C.C.	—	9d. light, 6d. power	1·97d.*	*To Switchboard.

Locality.	Date of opening.	Owners of works.	Engineer or manager.	System.	Station pressure.	L.T. distribution.	No. of consumers.	No. of 8-c.p. lamps.	Supply pressure.	No. and type of street lamps.	No. and H.P. of motors.	Plant capacity (kw.).	Boilers.	Engines.	Generators.	Units sold.	Price per unit.	Costs per unit.	Remarks.
Newcastle ..	1903	United Eng. Co.*	Allan Cameron	D.C.	440	Overhead 2-wire	120	4,000	220	Inc.	—	120	2 multi-tubular	2 Macintosh.	2 G.E.C.	—	1s.		*And S.A. Gen. Elec. Co.
Potchefstroom..	—	Consumers' E.L.& P.Co.	W. D. Ross	D.C.	245	Overhead 3-wire	70	5,000	240	10 arcs, 77 inc.	—	110	1 B. & W., 1 Dürr	2 Marshall	2	35,000	1s. 4d.	9d. (total)	
King Williams Town	1903	Municipality	A. Scott' power sta.	A.C. S.P. 5) ~ 200 v.	200	Overhead 2-wire	250	5,000	220	230 inc.	—	100	2 Paxman	2 Belliss	2 E.C.C.	83,835 (June, 1905)	1s.	9·18d. (total)	Additions in hand. *G. H. Lewis (outside),
Ladysmith ..	1903	Municipality	J. S. White	D.C.	440	Overhead 3-wire	159	—	200	4 arcs, 160 inc.	—	100	3 Robey	2 W. & R.	4 E.C.C.	—	8d. to 1s.		
Boxburg.. ..	1903	E. H. Gellender, Ld.	E. H. Gellender	D.C.	500	Overhead 3-wire	—	—	240	96 inc.	—	100	2 Paxman	2 Belliss	4 G.E.C.	—	1s.	—	Arbitration pending.
Aliwal North ..	1905	Municipality	A. A. Pashby	D.C.	460 to 500	Underground 3-wire, 460 & 230 v.	107	4,302	230 light, 460 power	72 Nernst	—	90	2 Achilles turb., operd. from Orange Riv.		2 Industrial	—	6d. & 4d.	—	256 Hart cells. During day power drives plant for water supply & irrigation.
Greytown ..	1904	Local Board	W. H. Blatchford	D.C.	220	Overhead, underground 2-wire fdrs.	68	2,300	200	35 incan.	—	75	2 Paxman	3 Alley & McLellan	3 Parker	8,827 (10 months)	1s.	8·75d. (total)	Street lighting extensions in hand.
Dundee	1902	Collins, Kessler & Co.	C. A. Hopton	D.C.	230	Overhead	135	2,900 (approx.)	190 to 220	138 incan.	—	70	2 Robey	1 Sentinel, 1 Simple	2 Parker	—	1s., 10d. & 9d.		
Heilbron.. ..	1904	Harris, Lee & Co., Ltd.	C. J. Duncan	D.C.	250	Overhead 2-wire	60	1,000	240	None	1 of 3½ H.P.	40	2 Paxman	2 Peache	2 Crompton	16,000	1s., 3d. & 6d.	9d. (total)	Water costs £1 10s. per 1,000 gallons.

TRAMWAY SYSTEMS.

Locality.	Date of opening.	Owners of works.	Engineer or manager.	System of supply.	Rolling stock.	Miles of route.	Rail details.	Plant.	Units last year.	Car-miles last year.	Passengers.	Costs.	Remarks.
Cape Town ..	1896	Cape Elec. Tramways Co.	A. S. Giles	550 v., D.C.; trolley	65 D.D., 15 S.D., G.E.C. & D.K. equip., 8 trailers, hand, Sterling slipper & elec. emerg. brakes	13·74 (single) 9·0 (double)	4 ft. 8½ in., 90 lb.	4 Heine and 4 B. & W. boilers, 1 Y. & T. engine, 1 Macintosh, 3 Philadelphia, 1 D.K. dynamo, 1 G.E.C., 3 Westinghouse (See Lighting List) 1 L.D. & M. Co. booster, 260 Tudor cells	3,425,473	2,026,073	15,020,503	Per c.m. 13·26d.	Year ending June, 1905. Track extensions in hand
Durban	1902	Municipality	H. N. Thomas	550 to 600 v., D.C.; trolley	40 D.D., 6 trailers, 7 others, Brill trucks, B.T.H. equip., hand and mag. disk brakes	13·5 (route) 22 (track)	4 ft. 8½ in., 87 lb.		1,548,649	1,097,230	11,848,191	9·9d. (operating expenses)	Year ending July, 1905
Port Elizabeth..	1897	Cape Elec. Tramway Co.	J. A. Barclay	550 to 600 v., D.C.; trolley	27 cars. 2 trailers, 1 sprinkler. B.T.H. equip., hand and mag. brakes	4·1 (single) 4·2 (double)	4 ft. 8½ in., 81 & 83 lb.	4 B. & W. boilers, 4 Macintosh engines, 4 G.E.C. dynamos	700,000	450,000	4,000,000		
East London ..	1900	Municipality	J. M. Lambe	550 v., D.C.; trolley	21 D.D. cars, Brill and Peckham trucks, E.C.C. G.E.C. and D.K. equip.	5½	4 ft. 8½ in., 76 & 85 lb.	(See Lighting List)	—	165,339	1,653,397	—	To Feb., 1905
Kamps Bay ..	1901	Kamps Bay Tramway Co.	— McDonald	550 v., D.C.; trolley	14 D.K., 4-motor single-deck bogie trucks, West. equip., 3 freight trucks. Chris. air and electric brakes	6·87 (single)	4 ft. 8½ in., 90 lb.	2 B. & W. boilers, 2 Y. and T. engines, 2 Dick, Kerr dynamos	340,927	147,264	526,864	Total 20d. per c.m. works cost. per unit 3·39d.	
Pietermaritzburg	1904	Municipality.	P. Finlayson	500 v., D.C.; trolley	16 D.D. West.-B.T.H. equip. Brush bodies; sprinkler; rheostat and hand brakes	6½ (route) 5½ (single) 1 (double)	4 ft. 8½ in., 90 and 65 lb.	(See Lighting List)	195,062	175,256	1,448,573		
Lourenco Marques	1904	Tramways Elec. de Lourenco M'ques	C. Satchell	550 v., D.C., trolley	15 S.D. 4-wheel McGuire trucks: hand and elec. brakes	7·76 (single)	3 ft. 3½ in., 76 lb.	2 Belliss engines, 2 Lanc. dynamos, 2 B. & W. boilers	—	287,519	721,078		
Alexanders-fontein	1905	De Beers Con. Mines, Ltd.	R. W. Smith	550 v., D.C., trolley	3 Stephenson Peckham trucks, West. equip., Chris. air brakes	5·8 (single)	3 ft. 6 in., 45 lb.	(See Lighting List.) 6 West. transformers 5,000 to 308 v., 2 West. rotary converters					

MISCELLANEOUS.

JOHANNESBURG Tramways in hand, 100 cars; 50 miles track 4 ft. 8½ in. gauge, a 30 miles route.

CLAREMONT (C.C.) (no official returns).—E.L. works in operation, owned by the Cape Peninsula Lighting Co. J. Hurry, electrical engineer. 3-phase A.C. 60 cycles, at 3,300 v. Transformed at sub-stations to D.C.; cons. pres., 220 & 440 v. Plant, 2 B. & W. boilers, 3 Parsons turbines; 433 KW. total.

KALK BAY & MUZINBERG (C.C.).—E.L. scheme, municipal, about starting; 3-phase A.C., 50 ~, at 2,000 v.; cons. press., 220 v.; B. & W. boilers and 2 West. alt.; 300 KW.

PORT ELIZABETH (C.C.).—E.L. scheme, municipal, start early 1906. R. Pape, electrical engineer. 3-wire, D.C., 500 v., cons. press., 250 and 500 v. Street ltg., 450 Nernst and 110 arcs. Plant 800 KW.; 3 Tinkers boilers, 2 Parsons-Brush turbo-generators.

The following towns have proposed electric lighting:—

TRANSVAAL.—Barberton (now trying acetylene gas); Standerton; Volksrust; Heidleburg; Krugersdorp; Kluksdorp; Pietersburg; Middleburg (town).

CAPE COLONY.—Umtata (acetylene gas proposed); Kokstad; Craddock; Wellington; Paarl (Bill thrown out); Queenstown (concession lapsed); Simonstown.

O.R.C.—Bethlehem; Winburg; Ladybrand; Fixburg; Jaggersfontein.

NATAL.—Vryheid.

BRITISH E. AFRICA.—Nairobia.

RHODESIA.—Salisbury (dropped for the present); Gwelo; Umtali.

BECHUANALAND.—Mafeking.

The following Tramway and other schemes have been proposed:—

TRAMS:—Pretoria; Buluwayo; Bloemfontein; Durban suburbs (Prospect Hall Estate); Somerset West and Somerset Strand (concession lapsed, steam railway in hand); Springs-Randfontein Railway (Transvaal).

Zambesi Power Distribution Veereniging, power distribution for Witwatersrand Gold Mines (Transvaal).

NEW PATENTS APPLIED FOR.

Compiled expressly for this Journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

15,860A/1905. "Improvements in and relating to the equalising conductors of dynamo-electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) (Date applied for under Rule 5 of the Patents Rules, 1905, August 2nd, 1905.) May 16th.

11,203. "Automatic (electric) safety fuse replacer." R. HOLDEN. May 14th.

11,217. "A trolley electric lamp-carrying apparatus, which is completely insulated as well as freely mobile." W. RANKEN. May 14th.

11,238. "Improvements in induction motors." J. E. RAWORTH. (A. V. Clayton, Sweden.) May 14th.

11,251. "Improvements in machinery for the magnification of small variations in an electric current." W. L. HILDBURGH. May 14th.

11,258. "Improvements in connection with incandescent electric lamps for preventing their unauthorised removal." C. A. HALES. May 14th.

11,268. "Improvements in the construction and working of the carbons of flame electric arc lamps." H. E. MOUL. May 14th. (Complete.)

11,279. "Improvements in filaments of incandescent electric lamps." A. BOURDOS, R. ROTHSCHILD and J. W. SUTCLIFFE. May 14th.

11,297. "Improvements in and relating to electrical transformers." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) May 14th.

11,298. "Improvements in generators, converters and alternate current motors." V. A. FYNN. May 14th.

11,300. "Improvements in rotary field magnets for single-phase and poly-phase electric current generators." BELGMANN-ELEKTRICITATS WERKE AKT.-GES. (Date applied for under Patents Act, 1901, May 20th, 1905, being date of application in Germany.) May 14th. (Complete.)

11,301. "Improvements in rotors for dynamos and electromotors." BERGMANN-ELEKTRICITATS-WERKE AKT.-GES. (Date applied for under Patents Act, 1901, May 20th, 1905, being date of application in Germany.) May 14th. (Complete.)

11,303. "Improvements in or relating to electric signalling apparatus." H. BECKER. May 14th. (Complete.)

11,317. "An automatic commutator for operating audible and other signals." G. ULMANN. May 15th.

11,335. "Improvements in electric switches." A. ECKSTEIN and A. C. HEAP. May 15th.

11,347. "Apparatus for controlling the trolley pulleys of electrically-propelled tramcars." W. S. REID and R. H. WEBB. May 15th.

11,367. "Improvements in telescopic floor standards for electric lamps." W. CASE. May 15th.

11,409. "Improvements in process of manufacturing tungsten compounds, and in the production of lamp filaments therefrom." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) May 16th.

11,430. "Improvements in detachable wall connections for electric lighting and heating." A. P. LUNDBERG and G. C. LUNDBERG. May 16th. (Complete.)

11,458. "Improvements in controlling systems for electric motors." W. COOPER. (Date applied for under Patents Act, 1901, May 22nd, 1905, being date of application in United States.) May 16th. (Complete.)

11,469. "Improvements re'ating to electric arc lamps." F. RUZICKA. May 16th. (Complete.)

11,493. "An automatic mechanical combination electric switch." A. E. KEEN. May 16th.

11,497. "Improvements in block signal systems for railways and the like." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) May 16th.

11,498. "An improved process for obtaining electrolytic metallic deposits." L. TRUNKHAHN. May 16th. (Complete.)

11,532. "Improvements in or relating to electro-magnets." M. B. FIELD. May 17th.

11,577 "A system of relays for automatically completing an incoming junction call after the insertion of the junction peg at a common battery telephone exchange." C. D. ILIFF. May 17th.

11,594. "Improvements in arc lamps." H. E. MOUL. May 18th.

11,603. "Improvements relating to electric and gas-light fittings." A. CLARKE. May 18th.

11,639. "Improvements in metallic incandescence filaments for electric glow lamps and method of treating the same." A. G. BLONAM. (J. LUX, Austria.) May 18th.

11,648. "Improvements in and relating to the mounting or supporting of electric motors on electrically-propelled vehicles." W. N. STEWART. May 18th. (Complete.)

11,652. "Improvements in electric batteries." E. BUHOT. (Date applied for under Patents Act, 1901, May 23rd, 1905, being date of application in France. May 18th. (Complete.)

11,657. "Improvements in electric heaters." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) May 18th.

11,658. "Improvements in electric heating devices." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) May 18th.

11,659. "Improvements in automatic controlling devices for electric circuits." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) May 18th.

11,667. "Improvements in electrical switches." F. OPRENDEK and S. POLLAK. May 18th.

11,668. "Improvements relating to electrically-propelled vehicles." H. H. LAKE. (Société Anonyme Electromotion, France.) May 18th. (Complete.)

11,675. "Improvements in effecting fusion of materials by electricity." G. F. BRINDLEY. May 18th. (Complete.)

11,676. "Improvements in devices for connecting the conductors of electric circuits, more especially intended for use in the 'wiring' of buildings for electric lighting." E. L. BERRY and F. HARRISON. May 18th.

11,690. "Electrical automatic controlling devices." J. W. RECORD and H. BEVIS. May 18th.

The Acetylene Blow-Pipe.—The use of acetylene for the production of very high temperatures is discussed by J. K. Rush in *Electrochemical and Metallurgical Industry*, May, 1906. Even as a source of heat alone it compares very favourably in cost with ordinary gas, if due allowance is made for its greater heating power. Its greatest interest, however, lies in the production of intense local heat. Using an acetylene blowpipe with air pressure, it is possible to bore holes through sheet copper, iron, mica, and even asbestos; in fact, the temperature is not far removed from that of the electric arc. With a suitable burner and a good generating apparatus no difficulty whatever is experienced in manipulation. The best mode of generation is the one known as the "dissolving process," in which case coolness is ensured, whereby a product free from objectionable contamination is obtained.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

ELECTRIC SWITCHES FOR USE IN CONNECTION WITH MOTOR CONTROLLERS AND FOR ANALOGOUS PURPOSES. Electric & Ordnance Accessories Co., R. F. Hall and J. R. Garner. 14,345. July 12th.

SPARKING PLUGS PARTICULARLY FOR USE WITH INTERNAL COMBUSTION ENGINES. F. H. De Veulle. 15,432. July 27th.

AUTOMATIC STARTER FOR ELECTRO-MOTORS. J. Jossen. 16,460. August 14th.

ELECTRIC ARC LAMPS. A. D. Jones and Jandus Arc Lamp & Electric Co. 16,545. August 15th.

TELEPHONE ATTACHMENTS. E. Wright. 18,380. September 12th.

ELECTRIC ARC LAMPS. A. E. Blondel. 19,712. September 29th.

NON-REVERSING TWO-WAY RUNNING TROLLEY POLE FOR ELECTRICAL TRACTION. H. Quertier. 20,960. October 16th.

ELECTRIC CONTROL APPARATUS. D. Bacon. 22,929. November 8th.

EXPANDING TERMINAL CONNECTION FOR ELECTRIC CABLES AND THE LIKE. C. H. Robinson. 23,662. November 17th.

CONTROLLER FINGER CONTACT FOR ELECTRICAL WORK. F. E. Ibeson. 24,183. November 23rd.

ELECTRIC FURNACES AND THE LIKE. T. Parker. 5,721. March 18th.

MEANS FOR ELECTRICALLY INDICATING AND RECORDING AT A DISTANCE CHANGES IN LEVEL OF LIQUID IN RESERVOIRS AND FOR GIVING WARNING OF ANY PRE-ARRANGED MAXIMUM OR MINIMUM LEVEL. P. V. Vaudrey. 7,732. April 11th.

TRANSMISSION OF ELECTRICAL ENERGY. H. H. Lake. (N. Tesla.) 8,200. April 17th.

ELECTRICAL SWITCHES. W. S. Mayer. 8,278. April 18th.

MANUFACTURE OF METALLIC FRICTIONAL BLOCKS SUCH AS BRAKE BLOCKS, ELECTRICAL COLLECTOR SLIPPERS, AND THE LIKE. T. Ashmore and P. McCullough. 8,344. April 19th.

ELECTRICALLY OPERATED SELECTING AND SWITCHING DEVICES APPLICABLE TO PARTY LINE TELEPHONE AND TELEGRAPH SYSTEMS. P. Arnheim. 8,410. April 19th.

CENTRAL BATTERY TELEPHONE SYSTEMS. P. Arnheim. 1,411. April 19th.

SYSTEMS OF ELECTRIC DISTRIBUTION EMPLOYING MERCURY VAPOUR LAMPS OR THE LIKE. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 8,567. April 20th.

REGULATION OF THE OUTPUT OF ELECTRIC GENERATORS DRIVEN AT VARYING SPEEDS. British Thomson-Houston Co., Ltd., F. Holden and A. S. Garfield. 8,570. April 20th.

ELECTRIC LIGHT CANDLE FITTINGS. H. Hirst and J. H. Collings. 9,181A. Date applied for under Rule 5 of the Patents Rules 1905, November 1st, 1905.

ALTERNATING ELECTRIC CURRENT GENERATORS. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 10,555. May 19th.

SYSTEMS OF ELECTRIC MOTOR CONTROL AND APPARATUS THEREFOR. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 10,892. May 24th.

ELECTRIC MOTOR CONTROL SYSTEMS. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 11,536. June 2nd.

CONTROLLING DEVICES FOR USE IN THE ELECTRICAL PROPULSION OF VEHICLES OR TRAINS OF VEHICLES. J. S. Raworth. 11,614. June 2nd.

DEVICES FOR MAGNETICALLY INCREASING THE ADHESION BETWEEN TRUCK WHEELS AND THE RAILS UPON WHICH THEY ROLL. R. C. Lowry. 12,296. June 13th.

ELECTRIC ARC LAMPS. W. R. Ridings. 13,025. June 23rd.

RECEIVING INSTRUMENT FOR WIRELESS TELEGRAPHY. C. V. Boys. 13,828. July 5th.

ELECTRO-MAGNETIC VIBRATORS. R. Cralstedt. 15,265. July 25th.

ELECTRIC SOLDERING IRONS. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 15,796. August 1st.

ELECTRICAL APPLIANCES FOR MASSAGE AND THE LIKE. C. Arens. 15,985. August 4th.

TYPE-CARRIERS FOR TYPEWRITING, TELEGRAPHIC, PRINTING AND LIKE MACHINES. J. P. L. Donlevy. 16,131. August 8th.

METHOD OF CONSTRUCTING AND LAYING UNDERGROUND MAINS FOR THE DISTRIBUTION OF ELECTRICITY. P. N. Hooper and A. Duckham. 16,249. August 10th.

ELECTRIC [illegible] A. D. Jones and Jandus Arc Lamp and Electric Co. 16,546.

ELECTRIC [illegible] LAMPS. B. M. Drake, A. D. Jones and Jandus Arc Lamp and Electric Co. 16,547. August 15th.

IGNITION GEAR FOR INTERNAL COMBUSTION MOTORS. J. Dunlop and D. Stewart and Co. 16,680. August 17th.

ACCIDENT-PREVENTING OR LIFE-SAVING APPARATUS FOR ELECTRIC TRAMCARS AND LIKE VEHICLES. T. A. Bennett. 18,076. September 7th.

TROLLEY WHEELS OR COLLECTORS FOR ELECTRICITY. W. K. Richardson. 19,691. September 29th. (Date applied for under International Convention, October 17th, 1904.)

OVERHEAD CURRENT COLLECTORS FOR ELECTRIC RAILWAYS AND TRAMWAYS. Siemens-Schuckertwerke G.m.b.H. 20,749. October 13th. (Date applied for under International Convention, October 27th, 1904.)

MAGNETO-ELECTRIC IGNITION APPARATUS. W. Roos. 24,293. November 24th.

MEANS FOR CONTROLLING AN ELECTRIC MOTOR. L. Krieger. 25,171. December 4th.

ELECTRICAL PROPULSION OF VEHICLES. L. Krieger and Compagnie Parisienne des Voitures Electriques. (Procédés Krieger.) 25,172. December 4th. (Date applied for under International Convention, May 24th, 1905.)

ELECTRO-MAGNETIC POWER HAMMER, DROP STAMP OR PRESS. T. H. Large. 25,550. December 8th.

PROCESSES OF PREPARING NITROGEN-OXYGEN COMPOUNDS BY MEANS OF ELECTRICITY. Westdeutsche Thomasphosphat-Werke G.m.b.H. 8,721. April 25th. (Date applied for under International Convention, April 7th, 1905.)

AUTOMATIC ELECTRO-MAGNETIC SANDING GEAR FOR USE ON ELECTRIC RAILWAY AND TRAMWAY VEHICLES. M. Cummins. 10,644. May 22nd.

1906.

TROLLEYS OR COLLECTORS FOR ELECTRICITY. E. A. Leake. 2,209. January 29th.

SHAFT BEARINGS PARTICULARLY APPLICABLE FOR DYNAMO-ELECTRIC MACHINES. P. M. Justice. (Bullock Electric Manufacturing Co.) 2,322. January 30th.

AUTOMATIC REGULATING DEVICE FOR PNEUMATICALLY CONTROLLED COLLECTORS SUPPLYING ELECTRIC CURRENT TO TRAINS OR ROAD CARS. R. Vontobel. 6,079. March 13th. (Date applied for under International Convention, March 14th, 1905.)

CURRENT COLLECTOR OR CONNECTION FOR MAGNETO-ELECTRIC IGNITION APPARATUS. Simms and Bosch. 1,507. January 19th.

DEVICES FOR DRYING ELECTRIC CABLES. E. Passburg. 1,820. January 24th.

MACHINES FOR THE ELECTRIC WELDING OF CHAINS, RINGS, AND THE LIKE. Küppers. 2,317. January 30th.

MARINER'S COMPASS. H. A. Johannesen. 6,659. March 20th.